THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVII. No. 1723.] LONDON, MAY 19, 1896. [48TH YEAR. PRICE 6d.

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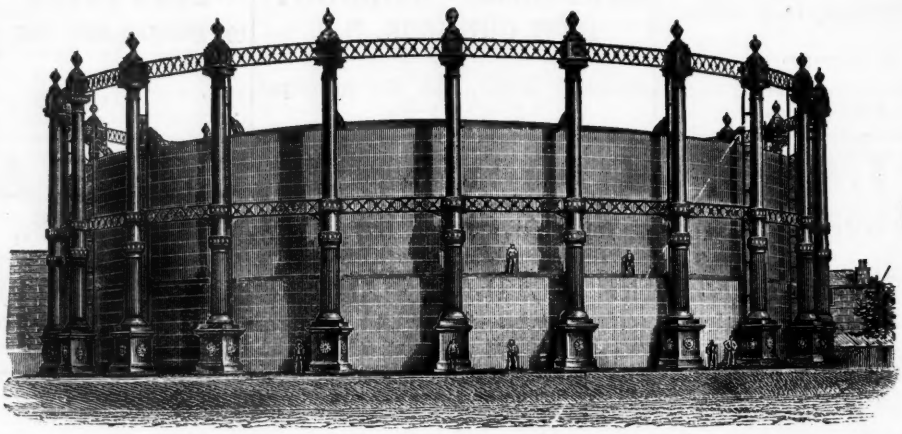

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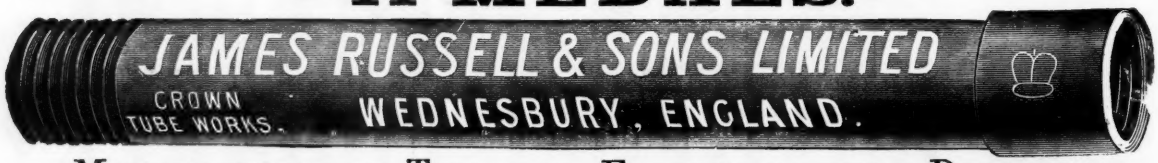

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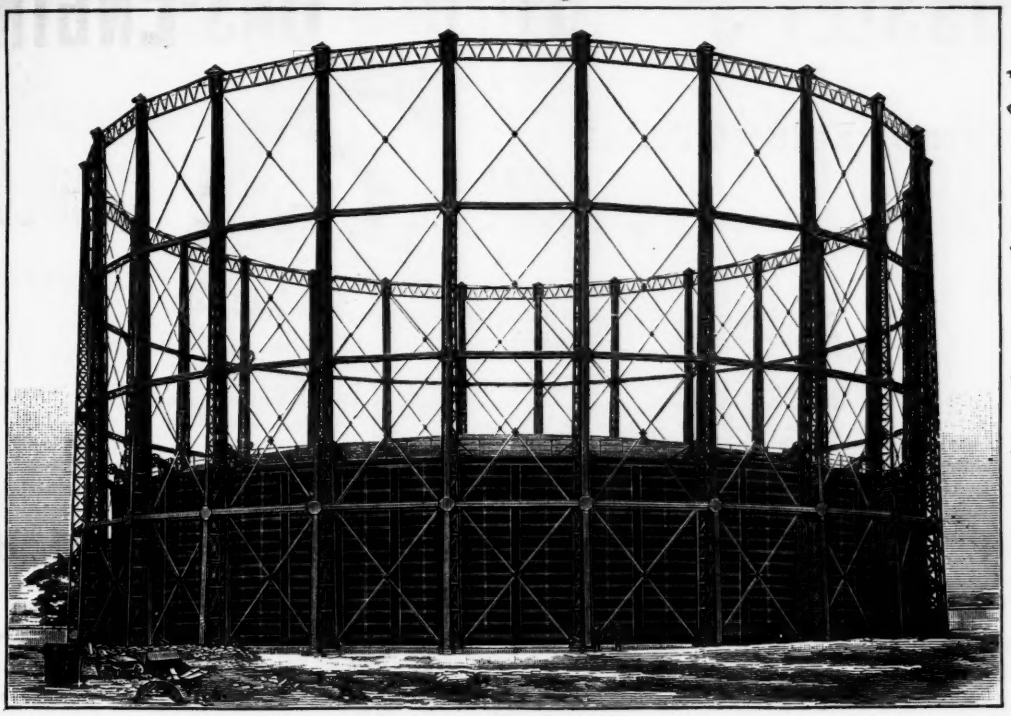

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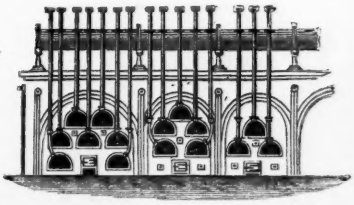

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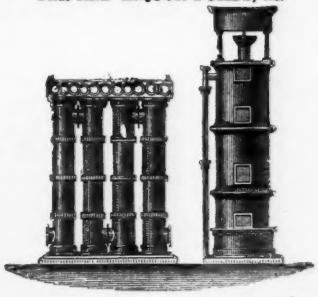

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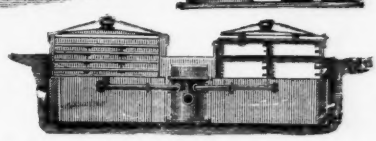

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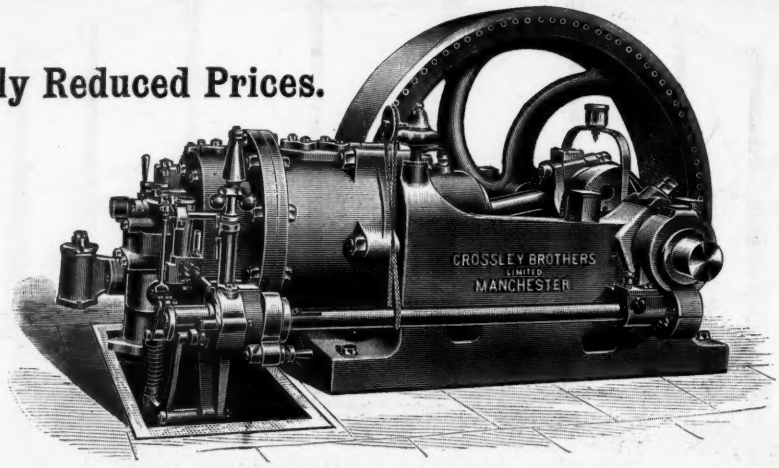

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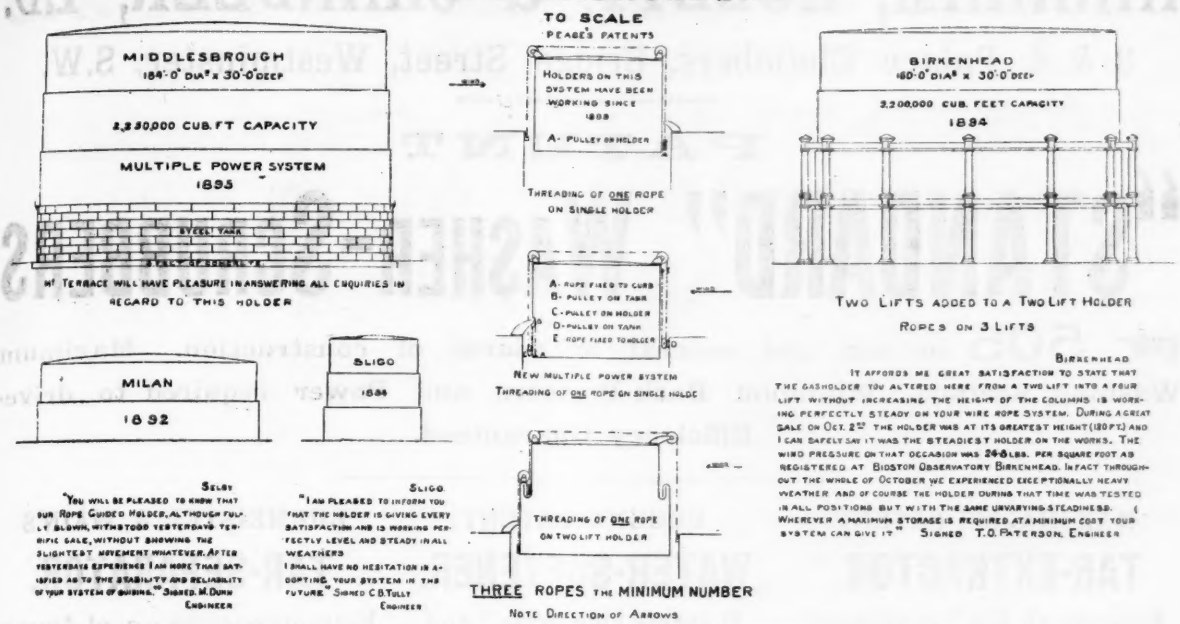
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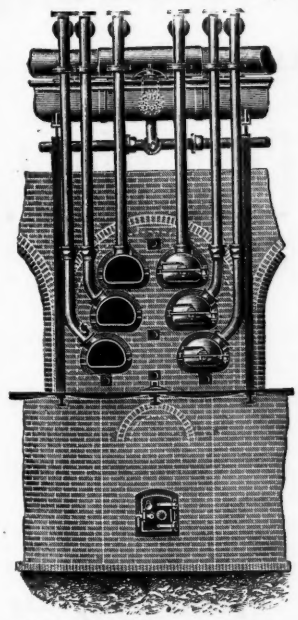

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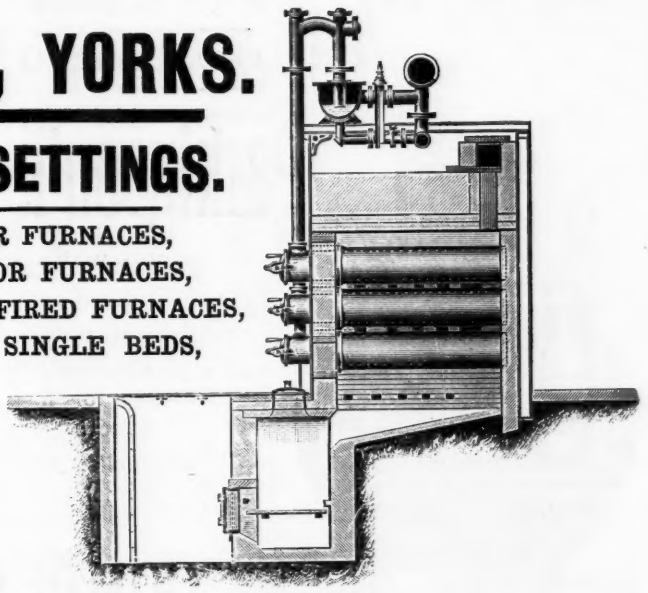

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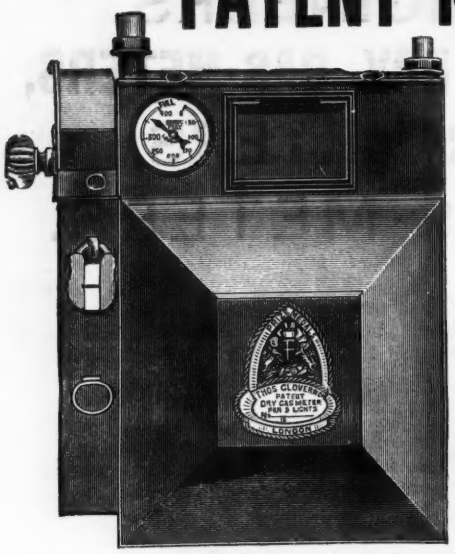

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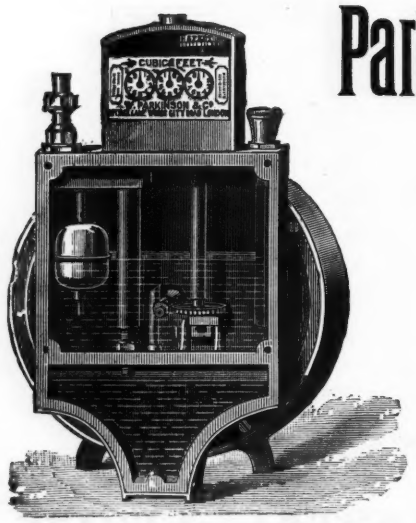

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[See also Advt. p. 1140.

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EDITORIAL NOTES.

The Meeting of the Institution of Gas Engineers.

THE meeting of the Institution of Gas Engineers last week was a decided success, both as regards the quality of the papers and discussions, and the number of members attending. The President—Mr. W. Foulis, of Glasgow—took the chair in succession to Mr. C. C. Carpenter, who has been a very popular President; and his Inaugural Address was of a highly suggestive and instructive character, as was to have been anticipated from the author's reputation. The Institution has so far been happy in its Presidents; but it might be said that a new technical organization of this kind, with the whole country to draw upon, would not have so much difficulty in finding Presidents at the outset of its existence as might occur later on. It is to be believed, however, that the Institution has yet several good men in sight for its highest office, and that the Council and members will be able to reckon upon getting valuable presidential addresses wherewith to begin the annual meetings for as far into the future as need be taken heed of in practical politics. But still better than good Presidents is the spirit that appears to inspire most of the members with the determination to keep up the interest of the meetings. The *agenda* of the gathering just held with such favourable results was not, on the face of it, of a particularly thrilling quality. Knowing how difficult it is for the best of councils and the most assiduous of secretaries of a technical society to always secure a promising lot of papers, and knowing also how easily some members of such societies are to confirm in the bad habit of staying altogether away from, or only putting in a perfunctory appearance at the meetings, we did not offer any criticism in advance regarding the promise of this *agenda*. It was impossible, however, to get up any enthusiasm over it; and our comments upon the whole programme were perforce of the briefest. The result goes to show how impossible it is to gather any reliable indication of the value or interest of papers, or the discussions they are likely to provoke, from the mere titles. It also shows that for a company which, if "fit," is also "few," a bill of technical fare which does not contain many entries will prove as satisfactory as a numerically fuller one, if only the respective items are good of their class.

Of the papers themselves, it is gratifying to be able to speak in high praise. None of them fell below the mark of acceptability by a technical audience of the best class, albeit there was not in the list a paper of extraordinary quality. Mr. Hunt's communication on the influence of carbonizing in bulk upon the nature and quantity of the products may mark the point of departure for a new era in gas-making practice, in which the raw material shall be treated by tons at a time, and the coke discharged in truck-loads. In the "JOURNAL," the standard system of carbonizing coal in a multitude of retorts has never been accepted as a perfectly satisfactory way of dealing with the material; and the ludicrous side of mechanical stoking, with its extravagant parade of weight and power for the purpose of superseding the man with a shovel, has not been lost sight of. Whatever may be the outcome of Mr. Hunt's paper, the gas engineering profession is indebted to him for clearing up a mystery and removing a doubt that have combined to bar the way to a particular line of experiment in carbonizing.

The subject of the standard of light has been placed upon a fresh footing by last week's meeting. Whether it is right or wrong to say that the recommendations of the Board of Trade Committee in favour of the substitution of Mr. Dibdin's 10-candle pentane standard for the actual candle have been shaken by what has since been learnt respecting the proposed new standard, it is at any rate certain that much has been published on the subject during the past year that calls for consideration before the further step of legalizing the new standard is taken. It was believed throughout the country that in the proposed 10-candle standard there would be made generally available, for technical as well as statutory purposes, a standard of artificial light exactly equal in value to ten candles. It was further supposed that this standard was easily capable of quick reproduction anywhere and at any time. It is not too much to say that grave doubts have

been cast upon the validity of these claims of the new standard of light to general favour; and whatever truth may underlie these suspicions, it is at least highly desirable that they should be examined by proper persons, and disposed of according to their worth. The claim of the industries of artificial lighting to have a good standard of light legalized for use in testing gas in this country is of greater importance even than the natural desire of the London Gas Companies to have a fruitful source of friction between themselves and the London County Council settled, at the price of a compromise, or than the natural ambition of individuals to immortalize themselves by this road. From the point of view of the lighting industries at large, the interference of the London Gas Referees and the London County Council in this matter of photometry has been an unmitigated nuisance from first to last. Before the present generation of Gas Referees and testing officers began to meddle with the photometer, a parliamentary standard candle was just a candle. Any artifical light capable of being measured in the photometer was stated to be of so many candle power, and there was an end of the matter. When, instead of persons practically conversant with the manufacture of gas, a set of men of the laboratory got hold of the business of gas testing, one fuss after another was forthwith made over different elements of the apparatus, with the object of giving the result of photometrical operations an exactitude which was foreign to their nature. "Hence these tears."

The interest of the Institution of Gas Engineers, we take it, in this question of legislation upon the standard of light, is altogether different from that of the immediate parties to the settlement which the Board of Trade is being moved to bring about. It is at any rate conceivable that the London Gas Companies, in order to get rid of a continual worry which occupies their advisers to the exclusion of far more important matters, might accept a standard which they know to be unfair or unsatisfactory in some respects. They might waive their objection to a standard rated (say) too low, if their complaisance were purchased by the grant of a more favourable way of treating the gas under test. We do not say that they would do such a thing, or consent to such a bargain. But the notion is not too monstrous a one for outsiders to entertain. On the other hand, everybody who is personally identified with a new standard of light, as with any other presumed improvement upon the appliances of civilization, would move heaven and earth to get that standard adopted. This is quite natural. Upon this debated field comes a third interest—that represented by the Institution Committee—which has only the one care, that any new standard shall be an unexceptionable one in all important practical respects. It is idle to object that the question of the standard is one that concerns London alone. What is fit for London should be good enough for the rest of the country; and any standard of light legalized for London use would speedily be copied for the rest of the country as opportunity presented—especially if it was thought to be against the Gas Companies—without those countervailing conditions which might have facilitated its adoption in the first instance.

Of the rest of last week's Institution proceedings not much remains to be said. The Council had the gratification of feeling that the meeting was a successful one; but they must also have perceived that there was not much in the transactions to fill out a book such as they have been able to produce hitherto. They will require to procure one or two good structural papers, abundantly illustrated, for their next Appendix. As already announced, the autumn meeting of the Institution is to be held in Glasgow, where the visitors will be entertained by the Lord Provost and the Gas Committee of the city; and Mr. Foulis will doubtless have much to show in explanation of some of the most striking portions of his address.

The Gas Affairs of Birmingham.

At to-day's meeting of the Birmingham Corporation, there is to be presented a report of the Gas Committee and their accounts for last year. The first subject dealt with in the report is the necessity for the further provision of manufacturing plant, and the conditions imported into this problem by the cost of supplying the various stations with coal carried by rail at the new rates. For several reasons, set out in some detail, the Committee recommend the addition of carburetted water-gas plant to the ordinary equipment of their Saltley and Windsor Street stations. At each works, a 2 million cubic feet set of such plant is authorized; and, as a matter of fact, the work has been put in hand at an estimated outlay of £60,000. There may be some question raised respecting this action of the Committee. But the various contracts have been pretty widely distributed. The Committee have also decided to try cyanogen-recovery plant at Saltley, upon the summer make of $3\frac{1}{2}$ million cubic feet per day, which will thus be running all the year. This is a good departure, and one that will be followed elsewhere. There is a passage in the report, to which the recent Chartered experience lends additional point, respecting the issue by the Gas Department of automatic prepayment meters. This course has now been resumed after the winter pressure on the fitters has ceased; but the Committee have learnt to be more circumspect and less complaisant in granting the use of meters of this class to those who apply for them. At the outset, all applicants were welcome. But it has been discovered that these meters can only be made to pay "by "the exercise of very close economy in the supervision "and management of them," and consequently the Committee are only supplying them in streets where others have already been fixed, or where there are six or more applicants for them. This is doubtless wise of the Committee. More than one gas company some time ago adopted the plan of making every applicant for a coin-freed meter in a new street bring with him applications from half-a-dozen or so of his neighbours. With regard to such meters paying, of course this is largely a question of the premium charged upon the ordinary price of gas, to cover the cost of fittings. It is the run upon capital that made the Chartered put the brake on; for even with the aid of a suspense account, a big concern soon locks up half-a-million or so in coin meters and fittings. And the needful money cannot always be readily found.

The Gas Supply of Paris.

In another column will be found our usual abstract translation of the report of the Directors of the Paris Gas Company for the past year, with the principal figures of the voluminous official statements of accounts. The results of the working of the Paris gas supply are always interesting; and this is especially true at present, as the undertaking is now showing the effect of various efforts made by the Directors with the object of popularizing the use of gas—efforts which the nature of the financial position of the Company prevents them from starting from the customary British procedure of a reduction in the selling price. For three years prior to the last, the consumption of gas in Paris showed a falling off, due, as was believed, to the new fashion of electric lighting and to the rapid spread of incandescent and high-power gas-burners in substitution for the less economical burners previously in general use. Last year, however, this downward movement was not only arrested, but the course of the undertaking was once more turned into the way of growth. The Directors believe that this is due to the circumstance that the applications of electric lighting in Paris are at present developing but slowly, and they are beginning to feel the ulterior consequence of the popularity of the new economical gas-burners in bringing fresh customers, and recovering others who have tried electric lighting and find that it did not bring them any advantages. The most important aid to the increased consumption recorded meanwhile is found to have been the new system adopted by the Company of laying on fittings free of charge to all tenements of less than 500 frs. annual rental. Upwards of 30,000 new consumers were added last year to the Company's books by virtue of this liberal policy. The Company also provide this class of consumers with suitable cooking-stoves gratis. Of course, this runs into money; but the Paris Gas Company must do their fitting work very cheaply indeed, inasmuch as their whole capital expenditure for the year was £310,237, which went almost wholly for distributing plant, as the manufacturing works are still ample for the requirements of the district, which touched the maximum demand for gas hitherto made upon the Company during the Exhibition year of 1889. Gas is being increasingly used in Paris for engines; and applications of gas power to working lifts and tramcars are hopefully regarded by the administration of the Company.

WATER AND SANITARY AFFAIRS.

SATISFACTORY progress is being made with the Bills of the London Water Companies. The Hybrid Committee of the House of Commons, presided over by Sir Joseph Pease, met on Tuesday, and proceeded to consider the Bill of the Chelsea Company. On Wednesday, the preamble of the Bill was declared to be proved, subject to certain amendments, which on Friday were introduced into the clauses, and the Bill was ordered to be reported. It is thus provided that the water at Seething Wells shall not be used for ordinary purposes, but only in case of emergency, or on the occurrence of an accident—notice to be given to the Local Government Board. The outlay to be authorized by the Bill is simply £50,000, to be raised by means of debentures. A duplicate main, adding 4 million gallons daily to the supply, is to be laid between West Molesey and Surbiton; and there is to be an additional acre of filter-beds at Thames Ditton. It was explained that the existing main from Molesey was only just equal to the wants of the Company's district; and a second main was therefore necessary to meet the growing demand. The Bill of the Lambeth Company, which, like the Chelsea Bill, had been held over from the previous session, came under consideration on Wednesday, and again on Thursday, when the preamble was declared to be proved. This Bill comprehends an outlay of £500,000 for new works, in order to maintain a sufficient supply. Mr. Balfour Browne, on behalf of the London County Council, said his clients desired to support the Conservators of the Thames in their endeavour to protect the river water from being "unduly taken" by the Company. Assuredly the Company will take no more than they can help, and will not fling the water away when they have pumped it up into their reservoirs. The true delinquents are found among a certain portion of the public, whose lavish use of the supply is a form of waste which the Companies cannot in all cases control. Even this excess of consumption is beneficial to the sewers, though unfavourable to the dividends. However, the worst that befell the Lambeth Bill at the hands of the Committee was a reduction to the extent of £10,000 in the power for a future purchase of land. It was also required that a sinking fund should be established, and an "emergency" clause inserted with respect to the supply from Seething Wells. The clauses were settled on Friday, at the same time as those in the Chelsea Bill, in which measure provision was likewise made for a sinking fund.

A commencement was made on Friday with the Staines Reservoirs Bill, promoted by the Grand Junction, West Middlesex, and New River Companies. This may be called the crucial project, as directly testing the feeling of Parliament with respect to the report of the Royal Commission and the sufficiency of the Thames. In this case provision is made for the next ten years, whereas the plan of which it forms part is designed to furnish an adequate supply for forty years. The ten years limit was thought by the County Council to be too long a period to allow in the case of the Lambeth Bill; but the Committee disregarded the objection. It is quite certain that the period is none too long, whatever may be done in connection with the Water Board Bill of the Government, or the Welsh scheme of the London County Council. Mr. Balfour Browne's argument, that the instructions given to the Committee bound them not to allow the Companies to carry out works which would forest all any future arrangements that might be made in regard to the London Water Supply, cannot be considered to forbid a period of ten years, Nothing will be "forestalled" within that limit of time. But the Staines scheme is a big one, requiring a million of capital, though even that is exceeded by the New River Bill, which asks for a million and a half; the Southwark and Vauxhall Company following up with a Bill for raising three-quarters of a million. The progress of these measures cannot fail to affect the position of the water question. The Welsh scheme already appears to be diminished to the magnitude of a "supplemental" supply. More properly it might be called "superfluous." The Staines Bill comes under further consideration by the Committee to-day.

The Metropolitan Counties Water Board Bill is beset by the risk of getting behind time in its passage through Parliament. The opponents of the measure affect to speak of it as being in a forlorn condition; and every attempt is made to exaggerate the difficulties with respect to the outside authorities. The recent conference held at the instance of the Surrey County Council has been pointed to as proving the hostility of the Metropolitan Counties to the Government Bill. But at that conference, after a resolution had been unanimously adopted declaring that the proposed Water Board was an "impracticable" scheme, another resolution was submitted, setting forth certain conditions which should be observed in the formation of such a Board. The official report says that "no formal "vote was taken on this resolution, but as the result of "the Chairman's detailed questions, it appeared that "Surrey and Essex were favourable, and Kent substantially so; while Middlesex opposed it, and "London, Hertfordshire, and Croydon declined to express "any opinion." What this signifies we may understand by observing that the conditions specified in the resolution are very much the same as those which Lord James of Hereford subsequently proposed to introduce as amendments to the Government Bill in Committee of the whole House. This again prepares us for the announcement which appeared in the "Pall Mall Gazette" a few days later, saying: "We believe that, in putting forward "these amendments, Lord James has secured the co-operation of all the authorities except that for Middlesex." Still further light is thrown on the situation by the Earl of Onslow's statement last Tuesday, that the Surrey County Council only that day had unanimously decided to withdraw their opposition to the Bill. As we intimated last week, the outside authorities ought to be aware of the fact that, in respect to their autonomous rights, they have far more to expect from the Government than from the London County Council.

PERSONAL.

Captain HAWKINS has joined the Board of the Burnham-on-Crouch Gas Company, to fill the vacancy caused by the resignation of Mr. R. G. Coombe, announced last week.

Mr. W. SHADBOLT, son of the Manager of the Fleetwood Gas Company (Mr. R. Shadbolt) has received the appointment of Assistant to Mr. J. B. Fenwick, the Gas and Water Engineer of the East Retford Corporation.

Mr. S. GLOVER, the Gas Engineer of the St. Helens Corporation, has received an advance of £50 per annum in his salary, in recognition of past services. As Mr. Glover is to take charge of the electric light works which are now being erected, the Gas and Lighting Committee have been authorized to make a further increase of a like amount, in two equal annual instalments, subject to their being satisfied that the duties of the office are properly discharged.

OBITUARY.

Mr. J. TEMPEST CHERRY, who in December last resigned the management of the Usk Gas-Works, after 44 years' service, died on the 4th inst., as the result of a few weeks' illness.

Mr. W. STATTER, J.P., F.R.C.S., died at his residence, Snapethorpe Hall, near Wakefield, on the 9th inst., in his ninetieth year. Deceased, it will be remembered, was the Chairman of the Wakefield Gas Company, with which undertaking he had been actively connected for about seventy years. When a young man, he was one of the Company's Auditors; between 1828 and 1834, he served intermittently as a member of the Committee of Management; and in the last-mentioned year, he was elected a permanent member of the Committee. In 1840, he presided over the first meeting of shareholders; and seven years later, he was appointed Chairman of the Company. He ably filled this position up to the time of his death. Last year the shareholders presented him with his portrait in oil, which now adorns the Board-room at the works. The deceased, who was an expert gas engineer, was the founder and Chairman of the Gas Companies at Mirfield, Ossett, Normanton, and other places. He started the Ossett Gas Company in 1855, the Mirfield Company in 1856, and the Normanton Company in 1869. He was also a Director of the Dewsbury Gas Company and of the Wakefield Water Company until the two undertakings were purchased by the Corporations of those places. He was Chairman of the latter Company at the time of the purchase. Mr. Statter had been a Magistrate for Wakefield from the formation of the Borough Bench. After having extensive practice as a surgeon, he retired about twenty-two years ago in favour of his eldest son, Mr. W. A. Statter, and removed to Snapethorpe Hall. Deceased was a prominent Freemason. In March, 1844, he founded the Wakefield Lodge 495, and was its first Master; and an excellent portrait of himself, which he presented to the lodge, now hangs in the Masonic Hall in Zetland Street. Deceased, who had been a widower since 1887, leaves five sons and three daughters. The funeral took place at Kirkthorpe last Wednesday.

THE INCORPORATED INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS,

MAY 13TH & 14TH, 1896.

Mr. WILLIAM FOULIS, M.Inst.C.E., President.

REVIEW OF PROCEEDINGS.

THE exceptionally fine and warm weather of last week was greatly in favour of a good attendance at the meeting of the Institution of Gas Engineers; yet it was not a numerous gathering that greeted the retiring President, Mr. C. C. Carpenter, when he took the chair in the lecture theatre of the Institution of Civil Engineers for the purpose of formally winding up the business of his year of office, and introducing his successor, Mr. W. Foulis, of Glasgow. The well-known head-quarters of the civil engineering profession in Great George Street, Westminster, have been rebuilt and vastly improved since last they sheltered a society of gas engineers; but the theatre has been altered least of any part of the building. It has been lightened by the construction of a new and loftier ceiling and dome; and it seems considerably more airy and commodious. Happily, its acoustic properties leave nothing to be desired on this score.

Mr. Carpenter has been one of the most popular Presidents the Institution of Gas Engineers has yet had, strong as the society is in gentlemen eligible for this high position; and he has richly deserved all the encomiums passed upon him on Wednesday, not only for his conduct during his year of office, but also for his devotion to the interests of the Institution from its formation. It is not too much to say that it is to the zealous attention of Mr. Carpenter, and other young gas engineers like him, that this organization owes the chief part of the success it has achieved as an agency for the cultivation and dissemination of sound technical knowledge.

The new President, Mr. Foulis, speedily found the way cleared for him and his address, which he began to read in the unimpassioned, yet impressive manner characteristic of his public utterances. Expectation ran high as to this address; the author being known for a man of original ideas, and perseverance in the way of their realization. The text of the address will be found in another column; and therefore it would be a work of supererogation to paraphrase it here. It must in fairness be said, however, that it more than justified the anticipations that had been formed respecting it as a suggestive contribution to the contemporary literature of the gas industry. Rarely has it been our good fortune to listen to a presidential address so full of matter of prime interest, marked, moreover, as to style, with that rare and precious quality of reserve which seemed to indicate at every turn that the speaker had it in his power to say a great deal more had he so chosen.

Circumstances had conspired to tempt Mr. Foulis into the easy, but too often tedious, way of reminiscence, for the bulk of his address. Nine years ago, in Glasgow, he occupied a similar position; and the temptation to enlarge upon the obvious text of "then and now" was too strong to be wholly resisted. To his credit be it said that Mr. Foulis touched upon this set of topics with a lightness which few of his countrymen could emulate. A good deal has happened in gas manufacture since 1887, which was an *annus mirabilis* in several respects. Looking back to this era from our present standpoint, we can see that really several important improvements in gas manufacture and utilization for lighting either started or took strength for fuller development about this time; and in most of this movement Mr. Foulis has taken a leading part. In his address he did not refer to his own achievements, which leaves us the freer to allude to them here. It is unnecessary to state in detail what Mr. Foulis has done for the gas industry during the past nine years or so; but whoever reads the technical history of this period, as recorded in the volumes of the "JOURNAL," will come across many references to the honourable labours of the indefatigable Engineer to the Glasgow Gas Department.

Not for long, however, did Mr. Foulis entertain his hearers with reflections upon accomplished facts. He soon led them to consider with him certain things which are not yet accomplished, and plunged into a luminous discussion of some of the deepest problems of coal carbonization. Some observations on a lesson to be learnt from coal-dust explosions showed how far, in the speaker's opinion, the present method of carbonizing coal is from realizing the best possibility actually within sight, to say nothing of ideal perfection. There is something in the President's suggestion that the process of carbonizing coal for the production of illuminating gas might with advantage be split up into two distinct stages. The notion is not, of course, an original one with Mr. Foulis; but there is as much merit in distinguishing the value of an idea often tried without permanently good results, as in hitting upon some entirely novel process. In gas manufacture, as in so many other industries, the failures of the past may still hide the germs of what may suceeed in the future.

The next subject that engaged the President's attention was, very naturally, the carbonization of oil. He briefly described what we believe to be an original system of his own devising, in which a stream of oil is first vaporized and then made into fixed gas by the agency of a pair of large vertical iron retorts maintained at a constant temperature by a gas-producer. The result, so far as enrichment goes, appears to be a marked advance upon previous methods, and has led Mr. Foulis to prefer the use of undiluted oil gas for this purpose to that of carburetted water gas. It seems, however, that this system must still lie under the reproach of being a "slow "business" which has been levelled at all pure oil-gas enrichment processes by those gas managers who want quantity as well as quality. It is no new discovery that in the manufacture of carburetted water gas most of the oil used goes to bring up the non-luminous product to the point of luminosity at which carburetting may be said to begin; but then, of course, the holder is going up merrily all the time.

Another topic upon which the President spoke with authority was that of the better utilization of the nitrogenous element in gas coal. Various methods to this end were reviewed in the address; the Presidential treatment of these leaving the impression as was probably intended, that this branch of technical study deserves to be taken up afresh. After this criticism, at all events, gas managers as a body will feel called upon to show cause why they should be content with recovering something less than a quarter hundredweight of sulphate of ammonia per ton of coal carbonized. Either as ammonia or as cyanogen, more of the nitrogen of the coal will have to be forthcoming than has hitherto shown itself in gas-works revenue accounts.

Finally, some instructive points with regard to the duty of gas burnt for lighting by the incandescent burners actually in the market brought to a conclusion an address fraught at once with profound theoretic speculation and close practical knowledge of the subjects comprised within its scope. As we have already acknowledged, Mr. Foulis has done many things for the good of the gas industry during the last nine years, and earlier in his professional career; but when the tale of his eminent services is made up—may the task be for the distant future!—his presidential address of 1896 will not rank among the least of the services he has rendered to his generation.

The first paper taken was Mr. Charles Hunt's "Notes on Residuals," which turned out to be, in the main, a description of the working of the Semet-Solvay coking-retorts at Brymbo, with more precise data respecting the quantity and quality of the gas made by this process of carbonizing coal in bulk than had previously been published. The paper, by a coincidence, filled in some of the outline sketched in an important part of the President's address; and it may also be read as a supplement to the article describing the coking plant at the Lanchester Colliery, Durham, published in the "JOURNAL" for Dec. 31 last. We do not propose to discuss the various papers here, as a better opportunity for doing so will occur later; but it may be helpful to our readers to state cursorily the nature of these communications, and note the impression they made upon the meeting. Mr. Hunt's paper, for instance, was valuable as a clearing-up of a point that has hitherto been obscure—that is, the influence of carbonization in bulk upon the quantity and quality of the gas yielded by the coal used. There are no means of knowing

exactly what the small coal or slack coked with recovery of residuals would do in ordinary coal-gas retorts; but Mr. Hunt's investigations at Brymbo (in which he was assisted by Mr. E. L. Pryce) go far to remove the previously prevalent idea that there must be a considerable difference, from the gas manager's point of view, between the results of the two systems of carbonization. The way is, in short, made clearer for a crucial experiment in some gas-works serving a district where there is a sale for oven coke, which shall show whether it is not possible to carbonize coal in retorts holding six tons instead of as many hundredweight.

Mr. Lewis T. Wright's paper on the "London" argand burner was a carefully-prepared disquisition upon a matter of high statutory importance, and was instrumental in evoking a discussion which afforded Mr. George Livesey an opportunity for communicating a useful bit of information respecting the contemplated action of the Board of Trade in regard to the standard of light. On the following day, these communications bore fruit in the nomination of a Committee of members of the Institution, charged with the duty of making representations to the proper quarter, when the right time arrives, concerning the phases that have come over the whole question of the standard of light since the Board of Trade Committee reported upon the subject a year ago.

The first business on Thursday was Professor Vivian B. Lewes's paper on "Incandescent Gas Lighting," which was one of the most brilliant of this prince of science lecturers' many triumphs before a similiar audience. The attendance of members on this second day of the meeting was noticeably larger than on the opening day. Professor Lewes appeared to tell all there is to be told about incandescent gas-burners; and if the recent legal proceedings left a somewhat lurid tinge upon the light in which he presented his subject, this was no more than was to have been expected in the circumstances. At any rate, the illuminating power was high, behind as well as upon the lecture-table, which was amply equipped with different patterns of incandescent burners, holophane globes, and other modern luxuries of gas lighting. This long paper, and the subsequent discussion, which was of a practical character, occupied the whole of the morning.

After the adjournment for luncheon, Mr. G. Livesey and Mr. W. W. Fiddes read their papers dealing in different ways with the general subject of the commercial measurement of coal gas in relation to temperature; and the two papers were discussed together. Mr. Livesey's was an amplification, and to some extent a correction, of the views he had already expressed on this subject; and Mr. Fiddes brought under the notice of his hearers a most ingenious appliance for the automatic regulation of meter measurement according to temperature. The principle of this invention is also applicable to thermometry, and the regulation of heating-stoves and other purposes; and we believe it has a wide future before it. Nothing cleverer of its kind was ever submitted to a gas engineering audience. Mr. Fiddes is also to be complimented on the exceedingly effective style in which his diagrams were prepared, in a boldly-conceived scheme of black and white shading, which we understand is both a quick and easy process, devised by Mr. Fisher, of Bristol.

The last paper—by Mr. A. F. Browne, on the enrichment of coal gas—proved to be a careful statement of the results of experiment in putting hydrocarbon vapour into coal gas at different points in the works' mains, with the object of assisting the gas to retain its naphthalene. Owing to want of time, the reading and discussion of this useful paper were hurried on. Indeed, had it not been for the facility afforded to the members by the previous distribution of prints of the paper, it could not have been discussed at all, which would have been a pity. Once more, therefore, this innovation has justified itself.

The visit to Hastings on Friday was very largely participated in, and was not the least instructive part of the business of the meeting, thanks to Mr. C. E. Botley, the Engineer and Manager of the Hastings and St. Leonards Gas Company, who had spared no pains to make the inspection of the gas-works an efficient object-lesson in the methods of the industry as carried on by a small, but enlightened, Gas Company bound down by the conditions prevailing in a South Coast residential and pleasure town. As stated in the specially prepared descriptive account put into the visitors' hands, in addition to the ordinary plant and equipment of a gas manufacturing station reconstructed and rearranged upon an old site, for an output of 3 million cubic feet of gas per day, "the works comprise a carburetted water-gas plant in course of erection; sulphate of ammonia works; specially-designed apparatus for the carburation of gas, either as a preventive of naphthalene deposits (which have in the past caused much trouble in the district) or for enriching purposes, or for both; a complete electrical installation, with storage batteries fitted by the Company's own staff, the object being not only utilitarian for certain special purposes on the works, but experimental, and demonstrative." The most novel of all these appliances is the naphthalene-preventive plant, the very name of which is enough to make every gas manager who uses a certain class of coal prick up his ears, especially when it is known that, so far as a year's experience can show, the device is completely successful in attaining its most desirable end.

To be as succinct as possible, as this is not the last mention we shall have to make of the arrangement in question, the Botley plant consists of a mechanical device for injecting, under considerable pressure, atomized petroleum burning oil into the bulk of the gas as it leaves the holder for the district. The oil at present used is the ordinary "Tea Rose" brand of commerce, which has a specific gravity of anything from ·820 to ·840. Of this no more than 0·02 gallon per 1000 cubic feet—or, in other words, 1 gallon to every 50,000 cubic feet of the output—is sprayed, by means of compressed purified gas, into the trunk main. The effect is to create in this main what can only be properly described as an "oil fog," which fills the main with a visible whitish cloud of oil vesicles. Everyone knows how permanent a thing a common atmospheric fog is; and this oil fog, being composed of non-volatile oil, is so permanent in the Hastings gas that it travels to the extremities of the district. Too small in quantity to directly affect the illuminating power of the gas, the oil nevertheless prevents the crystallization of the naphthalene in the gas; and thus practically solves the problem that has hitherto been so intractable. It does not dissolve much of the naphthalene out of the gas; the deposit of fluid in the street syphons being small in quantity, and the oil in it only containing about 6 per cent. of naphthalene. This device alone is worth a pilgrimage to Hastings to see in operation. It is the joint invention of Mr. C. E. Botley and his son, Mr. C. F. Botley, and is patented.

Our space fails, and therefore it is only possible to record the further facts that at Hastings the members of the Institution were most hospitably entertained by the Directors of the Gas Company; the luncheon given to the party at the gas-works being presided over by Dr. Gray, J.P., the Deputy-Chairman, in the absence through indisposition of the Chairman (Mr. G. A. Thorpe, J.P.). A drive along the celebrated sea-front and round the country at the back of the town followed, after which the party returned to London, and parted in the hope of meeting again in the autumn in Glasgow—the Institution having been invited thereto by the President, and by the Lord Provost and Gas Committee of the Corporation.

REPORT OF PROCEEDINGS.

The General Meeting of the Institution was held last Wednesday and Thursday, at the Institution of Civil Engineers, Great George Street, Westminster.

Mr. C. C. CARPENTER, the retiring President, occupied the chair at the commencement of the proceedings.

ANNUAL REPORT.

The PRESIDENT moved the adoption of the report of the Council—see "JOURNAL" for the 5th inst. (p. 972).

Mr. CHAS. HUNT (Birmingham) seconded the motion; and it was carried unanimously.

ADDITIONS TO THE ROLL.

The SCRUTINEERS reported that the following gentlemen had been admitted into the Institution:—

MEMBERS.

Allen, E., Gas-Works, Liverpool.
Cross, F. W., Gas-Works, Leyton.
Davis, J., Gas-Works, Gravesend.
Husband, J., Gas-Works, Brentford.

ASSOCIATE.

Tarratt, F. P., Gas-Works, Leicester.

The PRESIDENT said it was now his duty to introduce Mr. W. Foulis, his successor in the office of President. Whatever had been done for the Institution in the past, he was quite certain that the work would be exceeded by that which Mr. Foulis would devote to its affairs. He had been most sympathetic to it since its initiation; and he (Mr. Carpenter) was sure that its usefulness to the profession would increase under his guidance.

Mr. W. FOULIS (Glasgow) then took the chair.

THANKS TO THE PAST-PRESIDENT.

Mr. G. LIVESEY proposed a vote of thanks to the retiring President for his services to the Institution during the past year. He said he was to some extent responsible for Mr. Carpenter having consented to take the office of President, having urgently pressed him to do so; and he now had great pleasure in moving this resolution. He knew Mr. Carpenter to be a man thoroughly devoted to the profession of which he was an ornament; and whatever he took up he would put his heart into, and do his very best to make a success, as he had done in his official capacity in connection with the South Metropolitan Gas Company. He (Mr. Livesey) therefore had no hesitation in advising him to accept the presidency. He felt now that the Institution had not suffered in his hands, that he had done everything he could to promote its prosperity, and that he would retire with the entire respect and honour of the members.

Mr. HUNT, in seconding the motion, said they owed Mr. Carpenter a debt of gratitude not only for his services in the chair during the year, but for his unwearying exertions for the Institution. The members were not, perhaps, aware how much they were indebted to him for carrying on the work of the Institution in connection with the Secretary. It was only those who were on the Council who could realize how much labour fell upon the few members of that body living in the neighbourhood of London, who could appreciate the enormous amount of work which had devolved upon Mr. Carpenter.

The PRESIDENT, in putting the motion, said he desired to repeat what had been said by the mover and seconder. He was sure those outside the Council were unable to appreciate at all fully the extent of the work that Mr. Carpenter had done.

The motion having been carried by acclamation,

Mr. CARPENTER, in responding, said that what little he had been able to do for the Institution had been done out of pure love for it, and from the knowledge that his endeavours had been of some little use to the profession. He need not recapitulate his connection with the Institution, or the circumstances under which he was elected to the first Council; but if his work in connection with it had grown since then, it was because he had become more and more impressed with the belief that an Institution of this character was dependent for its success upon the members of the profession only, and not upon outside influences. For this reason he had endeavoured to carry on, to the best of his ability, the work which had fallen upon him; and he was sure that, as years went by, it would be realized more and more fully that it was only an institution founded upon such a basis as theirs which could hope to be of use, and to be respected by the gas engineering profession.

The PRESIDENT then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—I have to thank you very sincerely for the honour you have conferred upon me, in selecting me to be your President for the ensuing year.

It is now nine years—nearly a decade—since I occupied a similar position; and it may not be without advantage that I should in this address glance at the present position of the gas industry as compared with what it was then, and the progress that has been made in gas manufacture since that period, so that we may ascertain how far we have been able to improve the details of manufacture, and to increase our knowledge of the principles involved in the various processes with which we have to deal.

Nine years ago, it appeared to many that gas lighting might soon be superseded by its powerful rival—lighting by electricity. Companies and corporations owning gas-works hesitated to expend more capital; while electricians confidently asserted that gas lighting would soon be a thing of the past. At that time the amount of gas manufactured in the United Kingdom was 88,080 million cubic feet per annum. At the present time, it may be safely assumed (basing the calculation on the last published Board of Trade returns) to be not less than 118,000 million cubic feet. Then the number of consumers was 2,130,000. Now there are not less than 2,600,000; and in almost all towns large extensions of works are either in progress or in contemplation—results which clearly prove that the competition created by electric lighting has not materially affected the prosperity of the gas industry; while it has undoubtedly stirred up gas manufacturers to greater energy—healthy competition being a great factor, not only in the advancement of manufactures, but in all progress, and one of the most powerful stimulants to exertion.

Nine years ago manual labour was all but universal in gas-works. Inclined retorts had been heard of, but had no practical application, at least in this country; while stoking and other machinery had only been partially adopted in a few works. The advantages to be derived from substituting mechanical appliances for manual labour in gas-works were at that time generally considered doubtful, not only as regards the possible economy that might thereby be effected, but also because the consequences that would result from a breakdown of the machinery in mid-winter were regarded as being too serious to be risked. In contrast to this, it is now generally recognized that the large quantity of material requiring to be moved from place to place in gas-works can only be economically dealt with by means of machinery; and the benefit to be derived from getting quit of heavy and exhausting manual labour, and thereby securing the services of a better class of more contented workmen, is freely admitted. At the present time, in a considerable number of gas-works, the whole transference of material from the truck or ship to the coke heap is effected by machinery; thus greatly adding to the economy of manufacture. In my own experience at two works, where machinery has been largely introduced for dealing with both coal and coke, the saving in wages is not less than £20,000 per annum.

The use of regenerative furnaces for heating retorts is another improvement which has greatly extended during these years. The advantages of this system of heating are now generally admitted; and there are but few works of even moderate dimensions where it has not been adopted. A further development and improvement of this system will, I think, be found in having producers of large size, altogether separate from the retort-benches; the gas being led in properly constructed flues to the various retort-ovens, and possibly also to other parts of the works where heating or power is required. These producers might be supplied with forced draught, and so arranged that one or more of them would always be in the condition of maximum efficiency. The advantages to be derived from this arrangement are: The possibility of regulating the quantity of heating gas produced to suit the requirements; reduced cost of retort-bench construction; saving in labour; and, what is of still greater importance, more complete control over the retort temperatures, as the quantity of gas admitted to each setting, or to any particular point of a setting, could be regulated as required. A certain amount of direct heating might no doubt be lost. But with flues well protected against loss of heat, I do not anticipate that this would be found in practice to be very serious; and it would be more than counterbalanced by the advantages gained.

On the occasion I have above referred to, I directed attention to the importance of obtaining more accurate knowledge of the principles involved in the carbonization of coal. Although no great improvement has been effected in carbonizing since that date, the experimental observations that have been made during recent years on the composition of coal gas as influencing its illuminating power, and the experience gained in manufacturing gas from petroleum oils, have increased our knowledge as to the direction in which improvements are likely to be effected. It has, for example, been more clearly established than hitherto that the value of gas for illuminating purposes depends, not so much upon the proportions of hydrogen and carbon of which it is composed, as upon the manner in which they are molecularly combined, and that these combinations are the result, not of temperature only, but also of duration of exposure to that temperature.

It is now known, for example, that in making oil gas for the purpose of enriching coal gas, the best results are obtained when the oil is cracked up by long or by repeated exposure to a low temperature. A shorter exposure to a higher temperature will not produce the same result. It has also been proved that different results are obtained when the gases are exposed to radiant heat, from those obtained when they are brought into contact with red-hot surfaces.

The carbonization of coal, as at present conducted, consists of two distinct processes. There is first the distillation, or rather production of the hydrocarbon compounds from the coal, which takes place at a comparatively low temperature. Then there is the breaking up of the combinations of hydrogen and carbon thus produced into simpler forms, by exposure to radiant and contact heat in their passage through the retort. On this latter process depends to a great extent the ultimate condition of the gas. In order to distil the hydrocarbons from the mass of coal in the retort, a temperature must be maintained sufficiently high to enable the heat to permeate the mass in a reasonably short time. This temperature, however, may be much too high for the after-process of cracking up the hydrocarbons to produce the best results. Another consideration, which cannot be ignored as affecting the results, is the rapidity with which the gas is evolved from different qualities of coal—depending very much on the characteristics of the coal, both chemical and physical—as this determines the length of time the gas is exposed to the retort temperature.

These considerations lead to the conclusion that the present method of carbonizing coal is not the most scientific that could be adopted—first, because the temperatures are not sufficiently under control; and, secondly (and this has always seemed to me to be the weak point in our present method), because the gases formed at different parts of the retort are not subjected to the same heat influences. And they further suggest that probably, if the gases were evolved from the coal at a low temperature, and afterwards subjected to the influence of heat in a separate retort in which the temperature could be completely controlled, better results might be obtained.

This method of carbonizing was suggested in a paper read before the North British Association of Gas Managers in 1882; the proposal being that the coal should be carbonized at a comparatively low temperature in large chambers like coking-ovens—the hydrocarbon compounds produced in these chambers being afterwards passed through separate chambers or retorts, maintained at a constant temperature sufficiently high to crack or break them up into permanent gases. A system of carbonizing based on this principle would probably be found to possess many advantages over the present method; and any experiments which may be made in this direction deserve close attention. A process involving this idea was introduced a year or two ago. I refer to what is known as the Dinsmore process, some of the results obtained by which were very encouraging. It has not, however, had any extended application, probably from the practical difficulties encountered. The success of any such process will largely depend on the practicability of controlling the temperatures of the different retorts within a comparatively small range.

May I here venture to refer to some very crude and imperfect attempts at a method of coal carbonization, suggested on reading the report of experiments made by desire of the Royal Commission on Explosions from Coal Dust in Mines. In order to determine the force of such explosions, the air in a disused shaft of an old coal mine, 150 feet deep, was heavily charged with coal dust. This was fired at the bottom of the shaft. Instantly the flame not only filled the shaft but rose to a height of 60 to 70 feet above the surface.

We are not concerned with the object of these experiments; but what is of special interest is that here we have an example of the instantaneous production of gas from coal, and this suggested the following experiment: An iron tube, placed upright, was heated to a red heat. The tube was closed at the top end and water-sealed at the bottom; and a pipe connected near the top led to a small gasholder. Finely-powdered coal, allowed to fall in measured quantities through the tube, was completely carbonized in its passage. Of course, I do not suggest this as a practical method of carbonizing coal. I merely mention it as an interesting experiment well worthy of repetition and thorough investigation; for, if on further investigation, it be found practicable, it may lead to an ideal system of continuous, labourless carbonization.

Another important development, which has come into extensive use during the last nine years, is the manufacture of gas from oil. Although previous to that time occasional experiments had been made on the effect of enriching coal gas by means of oil gas, it was not looked upon as a process of any practical importance; and certainly there was no instance of its practical application. Who, then, anticipated that at the present time there would be no subject of greater interest to gas manufacturers, and that in many works throughout the country oil would be of almost as much importance as coal—an importance which will yearly increase as the supply of cannel diminishes? In connection with this subject, and as leading to an intelligent appreciation of the conditions which require to be fulfilled in enriching coal gas, the recent observations of Professor Lewes, Mr. Young, and others, on the chemical changes that take place in a gas-flame as affecting its illuminating power, are full of interest. These show that, in determining the enriching value of a gas, it is not sufficient to make a photometrical test of the undiluted gas, and by a simple arithmetical calculation estimate the effect it will have when mixed in certain proportions with gas of an ascertained lower quality. They rather indicate that gases of the same illuminating power, but of different composition, will produce widely different results when combined.

A statement of the results obtained in some practical experiments made under my direction on enriching coal gas by means of oil gas may be of interest. The object we wished to attain was to raise 16 or 17 candle gas to about 21 candles. The gas was made in two upright retorts of large capacity; the oil being vaporized and partly decomposed in the first retort, and the process completed in the second retort. The quantity of oil gas made in these retorts is about 70,000 cubic feet per day; so that the experiments were on a thoroughly practical scale. The photometrical apparatus was so arranged that small percentages of the oil gas could be thoroughly mixed with the coal gas. The following tabulated results give the quality of the undiluted oil gas; the quality of the coal gas; the percentage of the oil gas in the mixture; the illuminating power of the mixed gases; and the average retort temperature at which the oil gas was produced. The pyrometer was inserted in the centre of the retort; so that these temperatures may be taken as representing the temperature of the gas. The results given are selected from a great number of experiments as being typical of the whole:—

Coal Gas.	Oil Gas.	Percentage of the Oil Gas added to Coal Gas.	Illuminating Power of Enriched Gas Corrected to 5 Cubic Feet.	Enrichment Value of Oil Gas Calculated to 5 Cubic Feet.	Average Retort Temperature. Deg. F.
Illuminating Power Corrected to 5 Cubic Feet per hour.	Illuminating Power Corrected to 5 Cubic Feet per Hour.				
20·74	64·05	4·20	24·28	105·20	1100
20·45	60·88	4·90	23·69	86·60	1135
18·51	62·11	4·52	21·59	86·60	1145
14·65	74·00	4·00	19·77	117·00	1000
16·84	61·10	4·38	20·85	108·30	1070

It will be seen that 4·2 per cent. of oil gas distilled at an average temperature of 1100° Fahr., added to 20·74-candle coal gas, raised the quality to 24·28 candles; the enriching value of the oil gas being equivalent to 105·2 candles per 5 cubic feet. When the retort temperature was raised to 1135°, the enriching value of the oil gas fell to 86 candles; while gas produced at a temperature of 1000° had an enriching value equal to 117 candles. Taking into consideration the quantity of gas produced per gallon, an average retort temperature of 1070° gave the most economical results; 4·3 per cent. of oil gas made at that temperature being sufficient to raise 16·8-candle gas to 20·8 candles, or about 1 per cent. of oil gas per candle.

These figures show the very large increase in the illuminating value obtained when a properly made oil gas is mixed in certain proportions with a lower quality of coal gas, over the aggregate quality of the gases when burned separately. They also show that a comparatively small difference in retort temperature influences the quality of the gas to a large extent, not so much in the quality of

the undiluted gas, as in its power of enriching gases of poorer quality; and this suggests that better results are likely to be got when the oil gas is produced by a continuous process, in which the temperatures of the retorts are kept uniform, than by any intermittent system, in which the temperatures necessarily vary. A series of experiments was also made with carburetted water gas, of qualities varying from 25 to 50 candles. When mixed with coal gas, the lower qualities showed no increase over the undiluted gas; the higher qualities only a slight increase.

It would be foreign to the purpose of this address to enter into a discussion on the comparative merits of the different systems of manufacturing oil gas; but I may state that I have come to the conclusion, from practical experiment, that, for the purpose of enriching coal gas, undiluted oil gas is in every way more advantageous and economical than carburetted water gas. From the above figures, it will be seen that 960 feet of 16·8-candle coal gas and 43 feet of oil gas will, when combined, give 1000 cubic feet of 20·8-candle gas; the quantity of oil required being about $\frac{6}{10}$ of a gallon. One thousand cubic feet of the same quality of gas, enriched by means of (say) 25-candle carburetted water gas, could only be obtained by mixing 400 feet of the enriching gas with 600 cubic feet of the coal gas, and would require over $1\frac{1}{2}$ gallons of oil in its manufacture. Unless, therefore, under exceptional circumstances, or where a low quality of coal gas can only be produced at a much higher cost than is usual in this country, I have been unable to discover any advantage to be gained by diluting oil gas with a large quantity of non-illuminating gas, much of which is not only useless, but detrimental.

Another method of enriching coal gas, which has been successfully applied in recent years to a large extent on the Continent, and also in this country, is by means of benzene or light petroleum spirit. Of this method, I cannot speak from practical experience. One advantage it has over others is its great simplicity; but I doubt its efficiency in enriching gas more than 1 or 2 candles. I am of opinion that there will be a considerable extension of the various methods of enriching coal gas, not so much in order that a higher quality of gas may be supplied, as to enable the present quality to be manufactured from a lower quality of coal; thereby widening the sources from which coal supplies may be obtained.

It would be impossible for me, without unduly extending this address, to mention all the improvements effected during the past nine years. I might refer, for example, to the number of gasholders of large size now in use, in the construction of which guide-framing has been dispensed with; to the introduction of prepayment meters, which are being so largely adopted in many towns; and to many other developments in gas apparatus which would, nine years ago, have been considered impracticable. I might also devote some time to the consideration of improvements in the purification of gas; and to the increased knowledge we now possess of what is required for efficient purification, by means of which we are enabled to keep the amount of impurities in the finished gas well within the prescribed limits.

There is, however, one subject closely connected with purification on which I should like, with your permission, to make a few observations. I refer to the recovery and utilization of the nitrogenous compounds, which are, or may be, produced in the process of carbonizing coal—a subject which has received some consideration from gas engineers in other countries, but which has not received the attention it deserves from gas engineers in this country. In 1882, a very able communication on "The Production of Ammonia and Collateral Subjects connected with Coal-Gas Manufacture," by Professor Foster, was published in the "JOURNAL OF GAS LIGHTING," in which it was demonstrated that, while coal usually contains about 1·7 per cent. of nitrogen, only about 0·25 per cent. is evolved in the form of ammonia during the process of carbonization; and of the remainder, more than one-half is left in the coke—probably in some way combined with the carbon. The subject at that time received a considerable amount of attention; and Professor Foster communicated the results of further investigations in a paper read to the Institution of Civil Engineers in 1884. Since then, the investigations seem to have been completely abandoned; probably because their importance has not been fully appreciated. In some samples of coal, I have found as much as 2 per cent. of nitrogen, of which about 50 per cent. remained in the coke. If it were possible to recover the whole of the nitrogen contained in these coals in the form of ammonia, the quantity would be sufficient for the production of over $9\frac{1}{2}$ tons of sulphate of ammonia per 100 tons of coal.

Shortly before the date of Professor Foster's communication, a method had been discovered of extracting nitrogen from the coke of shale-oil retorts in the form of ammonia, by passing steam through it while highly heated; the quantity of ammonia thus recovered being about three times that formerly produced, which has added very largely to the profits of the shale oil companies. Several suggestions were made for the application of the same principle to the recovery, in the form of ammonia, of the nitrogen remaining in the coke produced in gas-retorts. One suggestion was that the coke should be dropped from the retorts into chambers, maintained at a high temperature, in which for a limited period steam could be blown through it; producing a certain quantity of heating gas, and at the same time recovering a considerable quantity of the nitrogen as ammonia. In another proposal, which is more practicable, the process was to be limited to the coke required for heating the retorts. A third suggestion was based on the discovery that when hydrogen—or a gas containing a large percentage of hydrogen — is blown through highly heated coke, a considerable quantity of the nitrogen may be recovered in the form of ammonia; and it was proposed to blow into the retort "water gas" towards the end of the charge. A fourth suggestion proposed that superheated steam should be blown through the coke in ordinary retorts, for a short time after the carbonization was completed.*

These suggestions point out the direction in which further investigations may be pursued with some hope of success; and although they have not so far led to any practical result, the subject is of so much importance that there is every probability that ere long means will be discovered by which it will be possible to recover, if not the whole, at all events the greater portion of, the nitrogen which is at present lost in the coke—a quantity equivalent to at least 50 lbs. of sulphate of ammonia per ton of coal. Even at present low prices, the value of the additional quantity of sulphate of ammonia which might thus be obtained from the coal carbonized in gas-works in this country is not less than £2,000,000 per annum.

In the same communication, Professor Foster showed that about 0·027 per cent. of the nitrogen in the coal was evolved as cyanogen, which, he states, "forms in the purifiers calcium cyanide and calcium cyanate. The calcium cyanate, being an unstable compound, slowly combines with the elements of water in the lime purifier, forming ammonia." That this is the true theory of the reaction which takes place in the lime purifier is, I think, open to doubt, as there is reason to believe that the cyanides are also decomposed; but, however this may be, he rightly concludes "that the practical outcome of these facts is that a lime purifier always tends to develop a quantity of gaseous ammonia, which is carried forward with the issuing gas"—a reaction with which those who use lime only in purification are more or less familiar, depending on the quality of coal used and the method of carbonizing.

Until quite recently, cyanogen was looked upon as an impurity, which might be utilized by being converted into ammonia, but which otherwise had no interest for gas manufacturers; and although several patents, dating from 1862 onwards, had been obtained for recovering it from coal gas in the form of ferrocyanide, no attempt had been made to extract it on a practical scale. The commercial importance of cyanogen has greatly increased, owing to its extended application as an agent for the extraction of gold from refractory ores. The interest now taken in its production may be inferred from the fact that, during the last three years, about 70 patents have been taken out in connection therewith; and the recovery of

* A process embodying the idea contained in this last suggestion is in practical operation in a works—not a gas-works—which I have had an opportunity of seeing since the above was written. The coal (a bituminous coking coal) is carbonized in ordinary gas-retorts; and I was assured that the quantity of ammonia recovered was equivalent to not less than 110 lbs. of sulphate of ammonia per ton of coal carbonized, and that, after deducting the quantity used for heating the retorts, 12 cwt. of coke remained for sale—showing that the additional quantity of ammonia was obtained without any serious deterioration in the quantity or quality of the coke.

this nitrogenous compound from coal gas during the process of purification is now of considerable interest to gas manufacturers. The subject is much too wide to be dealt with in this address; but the following general observations regarding it may be of interest.

The amount of cyanogen in coal gas varies considerably, and is largely dependent on the temperature at which the coal is carbonized. With high retort temperatures and three-hour charges, I have obtained as much as 100 grains of cyanogen per 100 cubic feet of gas. In some experiments made with gas produced at lower temperatures, only about one-half of this quantity was obtained. The results of some experiments recorded in an interesting paper read to the Société Technique de l'Industrie du Gaz en France, at their meeting in 1895, seem to indicate that the greater proportion of the cyanogen is produced during the latter hours of the charge—probably because at that period the temperature is highest; and in this connection it is interesting to note that Professor Foster found that ammonia was most abundantly produced during the earlier hours, and very little towards the end, of the period of carbonization.

In what particular combination the cyanogen leaves the retort is not known with any certainty. In the communication to the French Society to which I have just referred, it is assumed that it is combined with ammonia. I think, however, that this is more than doubtful. Cyanide of ammonium is a very unstable compound; and, as we have just seen, the ammonia is produced at a different period of the carbonization. The amount of cyanogen in the gas is not appreciably reduced in passing through the ammonia scrubber. In the ordinary process of oxide of iron purification, a considerable proportion of the cyanogen combines with the iron, forming a ferrocyanide, or prussian blue; but, for the reason above stated, the quantity so obtained will be much reduced if the gas has previously passed through lime purifiers.

The whole of the cyanogen may be recovered by passing the gas through an alkali (soda or potash) in a fine state of subdivision or in solution, in presence of an iron salt; the result being the production of a ferrocyanide of the alkali used. But these reactions will be much retarded if the ammonia has not previously been completely removed from the gas. I have been able, in practical work, to recover an amount of cyanogen equal to 4½ lbs. of crystallized ferrocyanide of soda per ton of coal carbonized. This is probably a larger quantity than would, on an average, be found in coal gas. There are, however, few works in which the gas does not contain a sufficient quantity to repay the cost of extraction.

The problems involved in the formation and extraction of these nitrogenous compounds are full of interest, and well deserve investigation. It would be of importance, for example, if we could ascertain what influences determine the combination of nitrogen with hydrogen to form ammonia, or with carbon to form cyanogen, as this might lead to a largely increased production of cyanogen, and possibly of ammonia. We know that retort temperature is a potent factor; but what other conditions are essential to their formation have yet to be discovered.

Next in importance to improvements in the manufacture of gas, and demanding equal attention and consideration from gas engineers, are improvements in methods for its utilization; and among these there is none more prominent or of greater importance than the method of utilizing the temperature of the bunsen flame to produce light, by rendering incandescent a structure composed of certain metallic oxides. This system of lighting had just been introduced in 1887; and many of us then seeing it for the first time doubted its suitability for ordinary use. Certainly no one could then have predicted the enormous development of this system of lighting, nor its effect on the gas industry in reducing consumption, and in enabling gas to compete successfully with other modes of lighting. I may, without attempting to discuss the principles involved in this system, refer to some experiments recently made, the results of which are of sufficient interest to be worth recording.

Apart from the question of the formation and composition of the mantle, which is the subject of so much controversy at the present time, the amount of light which may, by this method, be obtained from a cubic foot of gas depends upon the temperature of the flame; and this again is largely dependent on the air and gas being mixed in proper proportions in the bunsen burner. The following are the results of some experiments made in order to determine to what extent the efficiency of this system of lighting is thereby affected. The tests were made with the bottom of the chimney closed air-tight. The air and gas were mixed in a special appliance which ensured complete admixture; and both were carefully measured.

A mixture containing 1 of gas to 7 of air gave a light equivalent to 13 candles per cubic foot. With 1 of gas to 5·8 of air, the light increased to 28·2 candles per cubic foot—a much higher result than could be obtained in an open bunsen burner; and it fell to 17·3 candles when the mixture was 1 to 4. These figures I have selected from about thirty experiments; and they show how very sensitive this light is to the proper adjustment of the proportions of air and gas.

The following are the results of some experiments made in order to determine the influence variation in the quality of the gas has on the illuminating power of an incandescent burner:—

Ordinary Burner.		Incandescent Burner.	
Illuminating Power Corrected to 5 Cubic Feet.	Candles per Cubic Foot.	Illuminating Power Corrected to 5 Cubic Feet.	Candles per Cubic Foot.
23·1	4·6	117·3	23·40
17·9	3·6	90·3	18·07
16·2	3·2	87·9	17·59
14·6	2·9	84·4	16·89
13·5	2·7	81·9	16·39

These figures show a slightly greater relative efficiency with the lower qualities of gas; but this is more apparent than real, as the burner used was in all cases a flat-flame burner. A more suitable burner for the lower qualities would have given a higher quality to the gas, and a lower relative efficiency to the incandescent burner. With gases above 23 candles, the results are less favourable, probably because of the difficulty in getting a sufficiency of air mixed with the gas.

In order to ascertain what effect this system of lighting had on the gas consumption, there were selected 70 shops and places of business of different kinds, and at a distance from each other; the only reason for their selection being that they had largely introduced incandescent gas lighting. The amount of gas consumed, when compared with the amount consumed in the previous year, showed in the aggregate a decrease of 33 per cent., which could only be accounted for by the introduction of this method of lighting. Although the immediate effect of this economy in consumption may be injurious, it must ultimately be beneficial to the interests of gas manufacturers; establishing more firmly their position as suppliers of light, and, by cheapening, encouraging the use of lighting by gas.

In thus glancing backwards over the period I have selected for comparison, we find abundant evidence of advancement in every branch of the gas industry. It may be that no startling discovery has been made; but this is not essential to true progress. The discoveries that attract public attention, and which are sometimes looked upon as the result of a kind of inspiration, are only outward indications of the progress effected in the branch of science with which they are connected, and are the outcome of long and patient investigation without which no lasting scientific attainment is possible. The increased knowledge we are constantly acquiring regarding the natural laws which influence the chemical reactions and control the forces with which we are more immediately concerned, is gradually revealing to us the great possibilities that exist of further improvement in the manufacture and utilization of coal gas; and it may be safely predicted that ten years hence, on making a similar comparison to that which I have here attempted, it will be found that gas manufacture has progressed in a greater ratio than it has done in the past, and that the gas industry is established on a wider, and more secure basis, than it has been at any time in its history.

Mr. G. C. Trewby (London) moved that the best thanks of the meeting be accorded to the President for his address. It must, he said, have taken a great deal of time and trouble to prepare; and it would amply repay repeated perusal. He (Mr. Trewby) did not remember listening

to an address which bristled with so much controversial matter, and raised so many points which some of the members would no doubt like to discuss. Of course, this was out of the question now; but no doubt it would be done in future papers.

Mr. A. C. M'Minn (Kensal Green) seconded the motion, which was carried unanimously.

The President said he was much gratified to find that any trouble he had taken in preparing his address had given satisfaction to the members. He thought many would sympathize with a remark made by Sir Benjamin Baker, at a recent meeting of the Institution of Civil Engineers, to the effect that presidential addresses were obsolete institutions, that no one ever read them, and that they should be at once abolished.

Reading of Papers.

The reading of papers was then commenced. They were taken in the following order:—

Wednesday.—(1) "Notes on Residuals." By Charles Hunt. (2) "The Efficiency of the London Argand at Different Rates of Gas Consumption, with Special Reference to its Use as a Gas-Testing Burner." By Lewis T. Wright.

Thursday.—(3) "Incandescent Gas Lighting." By Vivian B. Lewes, F.I.C., F.C.S. (4) "Gas: Its Measurement in Relation to Temperature." By George Livesey. (5) "The Application of the Expansion of Fluids to the Correct Measurement of Gas." By W. W. Fiddes. (6) "Coal Gas Enrichment." By A. F. Browne.

The first three of these papers, with a report of the discussions on those read on Wednesday, are given in another part of the "Journal;" the remainder of the technical portion of the proceedings being held over for subsequent issues.

At the close of the discussions on Thursday afternoon, the general business was resumed.

Appointment of a Committee on Gas Consumption and Measurement.

Mr. Hunt moved, in view of the importance of the question raised by Mr. Lewis T. Wright's paper and the discussion which ensued upon it, that the matter be referred to a Committee for further investigation; the Committee to consist of Messrs. A. Colson, R. O. Paterson, C. C. Carpenter, G. C. Trewby, F. Livesey, C. Hunt, L. T. Wright, and J. Methven, with the President as an *ex officio* member, and to report either at the autumn meeting or subsequently. He further suggested that the matter raised by Mr. Livesey in regard to variations of temperature might be referred to the same Committee.

Mr. G. E. Stevenson seconded the motion, which was carried unanimously.

Votes of Thanks.

The President then moved a vote of thanks to the authors of the papers. He said if they had not been quite so numerous as on some occasions, they had been of a very excellent character; and the discussions also had been above the average in interest.

Mr. C. C. Carpenter, seconding the motion, remarked that, if anyone were particularly interested in any special question, and wanted to increase his knowledge of it, there was nothing like preparing a paper for the Institution. He hoped this would be borne in mind by members who had not yet favoured them in this way.

The motion was carried unanimously.

The President next moved a vote of thanks to the President and Council of the Institution of Civil Engineers, for granting the use of their hall for the meetings.

Mr. Methven seconded the motion; and it was carried unanimously.

The thanks of the members having been accorded to Mr. Magnus Ohren, the Honorary Auditor,

Mr. W. E. Price (Hampton Wick) proposed a vote of thanks to the Council, for the very able way in which the Institution had been managed during the past year.

Mr. T. Holgate seconded the motion, saying he was sure all the members would co-operate with the Council to the best of their ability in promoting the success of the Institution.

The motion was carried unanimously.

On the motion of Mr. Methven, seconded by Mr. T. B. Ball, the thanks of the members were accorded to the President for his conduct of the meetings.

The President, after thanking the members for the kindness with which his efforts had been received, proposed a vote of thanks to the Secretary (Mr. T. Cole), at the same time expressing the sympathy which he was sure they all felt with him in the circumstances under which he was about to take a rather long journey. They wished him a prosperous one, and a happy return.

Mr. Hunt had much pleasure in seconding the motion. Mr. Cole threw his whole heart into his work; and they all appreciated the value of his services.

The motion having been carried unanimously,

Mr. Cole, in responding, said no one in his position could have a better Council to work with; and it was therefore a double pleasure to do his best for the Institution. He should do his utmost to further its interests while on his travels.

The Autumn Meeting.

Mr. Carpenter asked if any arrangements had been made for the autumn meeting.

The President said nothing had yet been definitely settled; but he thought that probably about the end of September would be the most convenient time. He had been requested by the Lord Provost of Glasgow, on his own behalf and that of the Gas Committee, to invite the Institution to that city, and to assure them of a hearty welcome. The exact date would be fixed as soon as possible, and intimation would be given to the members by circular.

The proceedings then closed.

PAPERS AND DISCUSSIONS.

NOTES ON RESIDUALS.

By Charles Hunt.

The maintenance of industrial prosperity has in many directions become largely dependent upon the recovery and utilization of waste or residual products. Thus, in the manufacture of basic steel, the residual slag which at one time encumbered the ground is now a source of revenue—the phosphorus which it contains being a valuable plant-food. In the early days of gas lighting, tar and ammoniacal liquor gave but little trouble to the gas manager, except as to the method of their disposal without offence to the outer world. Now, however, not only are the returns from these residuals keenly criticized, but it no longer passes current that a deficient yield of tar is compensated for by increased production of gas, or that a small return for ammonia is to be wholly attributed to variations in the quality or description of coal carbonized. At any rate, in the author's experience, as stated in a paper read by him before the Institution of Civil Engineers in 1894, "On the Construction of Gas-Works,"* the highest production of gas has been accompanied by the largest yield of tar and ammoniacal liquor; which result, it may be added, has been obtained from small charges of coal carbonized at moderate as distinguished from high temperatures. This is not inconsistent with the known fact of variation in the yield of tar from different kinds of coal, altogether independently of the temperature of carbonization.

With respect to ammonia, however, the case is somewhat different. It has been repeatedly pointed out by Foster and others, that all gas coal contains very much more nitrogen than is represented by the highest yield ever obtained of ammonia; and, having regard to the temperature at which this substance may be decomposed, it seems highly probable that much of it is destroyed after formation, by contact with an overheated portion of the retort. Otherwise it is difficult to account for the great superiority of the results which are obtained from a moderate temperature coupled with fairly even charging.

Another nitrogen product—viz., cyanogen—has lately sprung into prominence, due to the use of potassium cyanide in the M'Arthur-Forrest process for the recovery of gold from "tailings." Its presence in coal gas has, of course, long been known; and many years ago it might have been described as the *bête noire* of the dry process of ammonia extraction as occasionally practised—any appreciable quantity of it rendering the ammonia salts formed

* See "Journal," Vol. LXIII., p. 651.

in the purifiers practically valueless for artificial manure. Its extraction has formed the subject of many patents, into the merits of which it is not necessary to enter; but until lately the only method practised was by means of oxide of iron, which, when spent, often contains a considerable quantity of prussian blue. Spent oxide of iron has, in fact, been for many years treated for this product in Germany, where, owing probably to the presence of a large percentage of cyanogen in the gas, the quantity recovered is occasionally very considerable. Members of this Institution are doubtless familiar with the very interesting paper on this subject by Dr. Knublauch, a translation of which appeared in the "JOURNAL OF GAS LIGHTING."* Dr. Knublauch appears to have made a special study of cyanogen in connection with gas manufacture, and may be deemed an authority with regard to it.

The gas industry is, however, indebted to Mr. William Foulis, the President of this Institution, for probably, if not actually, the first application of a separate and direct process for the extraction of cyanogen from coal gas, and its production in a saleable form.† Briefly described, and without going into details, this consists in bringing the gas, after the removal of ammonia, into intimate contact with a mixture of sodium and ferrous carbonate. The hydrocyanic acid contained in the gas combines with the mixture to form ferrocyanide of soda, which is run off from the washer as fast as produced. This crude ferrocyanide is evaporated nearly to dryness in large pans, then ladled out and allowed to cool, when it becomes solid. In this condition, it is said to contain about 75 per cent. of sodium ferrocyanide, and was recently saleable at about 4d. per pound. Its present value, however, owing probably to increased production, is somewhat less.

The quantity of this new residual product which may thus be extracted from the gas varies considerably; all experiments tending to show that cyanogen is essentially a high temperature product. Thus the author has found from experiment that gas which is produced under what may be called moderate heats—viz., from 1500° to 1600° Fahr.—yields only about ½ lb. of crystallized sodium ferrocyanide per 10,000 cubic feet of gas made (corresponding roughly to one ton of coal carbonized); whereas with higher heats, ranging from about 1700° Fahr. upwards, a yield of from 3½ lbs. to nearly 6 lbs. may be obtained. In connection with these results, however, it can hardly be without significance that the smallest yield of cyanogen is accompanied by a very abundant yield of the other nitrogen product, ammonia; the average of six months' working being represented by upwards of 40 gallons of 10-oz. liquor per ton of coal carbonized. It therefore appears that the conditions which are unfavourable to the production of cyanogen are favourable to that of ammonia, and *vice versâ*. It has been suggested as not improbable, judging from the entire absence of nitrogen in many samples of gas which have been formed at high temperatures, that ammonia at high temperatures, in the presence of hydrocarbon gases, is not broken up into its elements nitrogen and hydrogen, but that its nitrogen combines with carbon to form cyanogen (CnN_2).

A considerable amount of capital has, it is understood, been already embarked in the production of cyanides by various processes; so that there is evidently among manufacturing chemists a very fair amount of faith in the permanence of the demand for them. By no process, however, can cyanogen be obtained so cheaply as by extraction from coal gas, when the circumstances are sufficiently favourable; and as the operation is fairly simple, and the materials required are inexpensive, it may be reasonably hoped that a new source of revenue has thus been opened up which will in some measure redress the balance of the old—that what has, to all appearance, been permanently lost in the altered value of ammonia may, to some extent, be restored by the utilization of this, practically speaking, new residual.

Although carbonizing in bulk may at first sight appear to be but remotely connected with the subject of residuals, it will, upon consideration, prove to be intimately associated with it. When the Simon-Carvès system of coking was introduced into England some years ago, the author was led to hope that in some such plan might be found a solution of the labour question as affecting gas manufacture; and he so expressed himself in his Presidential Address to The Gas Institute in 1881. The idea, however, seemed at that time to be almost too venturesome to follow up. But, without being at any time actually abandoned, it has been revived by the rapid and practical advances in the same direction which have been made on the Continent during recent years, and which are, in a great measure, the cause of the fall in value of tar products and ammonia. When on a visit to Belgium with the Iron and Steel Institute during the autumn of 1894, the author was enabled to realize by actual observation the large scale on which recovery of residuals is being pursued there in connection with the manufacture of coke for metallurgical purposes; and it was but natural to contemplate what might be the effect upon the values of gas residuals of an extension of the system here, where many million tons of coal are annually used in this industry.

In what light, then, ought the system to be regarded? Ought it to be approached as a possible ally, keeping in view its advantages in the saving of labour? or must its advances be watched at a distance, as those of, to all outward appearance, an intractable competitor? To the believer in moderately thin charges as a means of economical carbonization—and who among gas makers is not?—this method of carbonization by charges 4 and 5 feet thick, and weighing from 4 to upwards of 6 tons, can present but little attraction. And yet there has existed, in what has been known of the production of tar and liquor, evidence that the yield of gaseous products by this system does not greatly differ from that which is obtained by the method of carbonizing as employed in gas-works. For instance, an average production of 10 gallons of tar and 25 lbs. of sulphate per ton of coal carbonized has been claimed for the Otto-Hoffman oven—a type which is largely used in Westphalia, although but little known in England. As, however, recovery of the bye-products is the principal object of the ovens, no steps have till recently been taken to ascertain definitely the yield of gas, most of which has hitherto been used for heating the ovens.

Previous, however, to the visit already referred to, the author had been permitted, through the courtesy of Mr. J. H. Darby, to inspect the coke-ovens erected by him for the Brymbo Steel Company, which are of the kind known as the Semet-Solvay,* and had caused samples of the gas to be taken, the analyses of which gave evidence of its substantial identity with that produced in the ordinary way in gas-works. This did not, however, carry conviction at Brymbo, where the gas had a very poor reputation as an illuminant. Accordingly, more samples were taken, which at once revealed the fact of large and irregular dilutions of atmospheric air, owing to the exhauster being imperfectly controlled. This defect being remedied, a marked improvement in the illuminating power was the result; and from that time the gas has been used for lighting the works and offices—displacing the gas which was formerly manufactured for this purpose. The analyses referred to are given below, and compared with analyses of London and Birmingham gas. It is evident that at the time the first samples were taken at Brymbo the ovens were working under a slight pressure. Hence no nitrogen was recorded. But on the second occasion a large quantity of air was being drawn in. In other respects, there is a very fair agreement in composition with the two other gases with which it is compared; the hydrogen, however, being in excess, and the marsh gas somewhat deficient.

—	Gas from Brymbo Coke-Ovens.			London Gas (Gaslight and Coke Company).	Birmingham Gas (Windsor Street).
	No. 1.	No. 2.	No. 3.		
H_2S . . . }	3·8	0·8	—	—	—
CO_2 . . . }		3·3	—	—	—
O_2	—	—	—	0·1	—
C_nH_2, &c. . .	4·3	3·7	3·7	4·7	4·9
CO	10·1	9·9	9·8	7·5	6·8
CH_4	29·6	22·9	29·4	34·2	37·5
H	52·2	45·9	57·1	49·2	46·2
N (by difference)	—	13·5	—	4·3	4·6

Nos. 1 and 2 unpurified.

Although here was fairly safe ground to go upon, it was felt that, to set all doubts at rest, the gas ought to be measured, and the illuminating power at the same time ascertained in the usual way. Ultimately the proprietors

* See Vol. LXVI., pp. 1242, 1294.

† See "JOURNAL," Vol. LXI., p. 830; also *ante*, p. 229.

* See "JOURNAL," Vol. LXIV., p. 781.

of the ovens decided to furnish a station meter; so that the actual value of the system for the production of illuminating gas has now, for the first time, been ascertained. Before stating the results obtained, it may be useful to describe shortly the arrangements at Brymbo, where the plant is capable of dealing with about 100 tons of slack per 24 hours, and comprises a battery of 25 ovens.

The slack is first washed in one of Robinson's coal-washing machines, which separates about 15 per cent. of impurities. It is then allowed to drain for about 48 hours, and is afterwards fed into a Carr's disintegrator, by which it is roughly powdered. In this state it is elevated into a hopper, from which it is supplied to the ovens as required. The ovens are narrow chambers, about 32 feet long by 5 ft. 7 in. high, and are about 15 inches wide at the ram end, increasing to 16 inches at the other. The distinctive feature of this type of oven is that the heating flues, instead of being built in the division walls, as is usually the case, are formed separately, so that they can be replaced when needed without disturbance of the permanent portion of the structure. This also enables the sides of the flues to be made thinner, by which the oven is more effectually heated. There are three flues on each side, built one above the other, and running the whole length of the oven. Into the top flues, on the ram end of the oven, a portion of the gas made, after being deprived of tar, ammonia, and light oils, is admitted. It is then supplied with a regulated quantity of heated air, and the resultant gases are drawn by the chimney draught to the other end of the top flue. Here they descend into the second flue, where further regulated supplies of gas and air are admitted; pass again to the front of the settings, and descend into the third side flue. Upon reaching the other end of this, the gases pass down from each side into a flue forming the bottom of the ovens; and flowing along this to the ram end, they reach the main waste-gas flue, which is built underground. Before reaching the chimney, however, they are utilized for raising steam in two Babcock and Wilcox boilers, and are capable of converting about 560 gallons of water per hour into steam of 60 to 80 lbs. pressure. This is sufficient, when the washing and powdering operations are performed at different periods of the day, for working the entire plant of 25 ovens.

Each oven has three openings at the top, through which it is charged with about 4 tons of powdered slack, which is supplied from small trucks with bottom doors, pushed from the mouth of the hopper along three lines of rails extending the length of the settings. There is also an opening at the top through which the gaseous products make their way by an ascension-pipe into a hydraulic main. When a charge on coal is burnt off, which takes about 22 hours, the valve of the ascension-pipe is closed, the cap removed, and the three covers taken off the charging-holes. The iron doors at the front and back of the oven, which extend its entire height and width, are then opened, and the coke is pushed out by means of a steam-ram in about two minutes. All openings are then luted up, and the three truckloads of slack dropped in and levelled with rakes thrust through small openings in the front and back doors. The discharging-engine, which travels the whole length of the settings, is supplied with steam by means of swivelled steam-pipes. Motion is communicated by two small cylinders to a pinion working in a rack extending the whole length of the ram-shaft.

The tar and ammonia are removed from the gas by means of a hydraulic main, air and water condensers, and a small washer—the tar from the condensers being pumped back into the hydraulic main to lessen the formation of pitch. The tar is sold as such; but, owing to the absence of light oils, it does not appear to command quite so good a price as gas-works tar. The ammoniacal liquor is worked up on the premises into good grey sulphate. A small portion of the gas on leaving the washer is purified by lime, and used for lighting the offices and works, being carburetted when necessary with a little benzene. The remainder passes to the absorber or washer, through which about 8 gallons of heavy tar-oil are run per hour. This removes the light oils from the gas. These are recovered from the absorbent tar-oil by steam distillation; the tar-oil being then ready for re-use. The gas now passes through the meter to the coke-ovens; after heating which the surplus is used in the adjoining steel-works. Provision is being made for measuring separately the gas required for heating the ovens; and it is also intended to treat the gas for the purpose of recovering cyanogen, of which there has been shown by experiments to be present at this part of the plant a quantity equal to about 2·7 lbs. of crystallized sodium ferrocyanide per 10,000 cubic feet of gas.

During a test of 48 hours' duration, the coal used being partly gas and partly steam slack from neighbouring collieries, the quantity carbonized was 210½ tons. This, however, contained about 10 per cent. of water; the quantity of dry powdered slack being 189·3 tons. The quantity of gas made during this period was 2,158,000 cubic feet (corrected to 60°), or 11,398 cubic feet per ton of dry powdered slack. As about 15 per cent. of impurities is removed from the slack by washing, the make of gas per ton of the original dry slack works out at 9689 cubic feet. The above quantity of coal was carbonized in 54 charges; so that 3·9 tons of slack were put in per charge.

Ten observations of the illuminating power were made at regular intervals; the average of them being 15·20 candles when tested at the standard 5 cubic feet per hour rate, and 16·34 candles when tested with the chimney fairly filled with flame, and afterwards corrected to the 5-feet rate. The burner used was the No. 1 "London" argand. The average impurities were: Carbonic acid, 2·60 per cent.; sulphuretted hydrogen, 0·52 per cent.

The area occupied by the 25 ovens, with coke-floor and travelling room for the discharging-engine, is a space about 100 feet square.

It is stated that eight months' working of the ovens shows an average yield per ton of dry powdered slack of 28 lbs. of sulphate, about 9 gallons of tar, and 13·95 cwt. of coke; while the light oils recovered from the gas ranged as high as 3·4 gallons per ton—the average, however, being less than this. The yield of tar is thus seen to be deficient in quantity as well as quality, although this is probably due, to some extent, to the use of slack, which generally yields less tar than large coal. In other respects, the results as to both gas and residuals are comparable with the usual gas-works method of carbonizing; while the duration of the charges, which by this type of oven is reduced to 22 hours, as compared with from 36 to 48 hours with other types, brings this system of carbonizing nearer to the requirements of a gas-works than it has ever been before.

It has, however, still to be shown that the ovens can be economically heated with producer gas made from coke or inferior coal; and also that the shorter time occupied in carbonizing is sufficient for the production of the most valuable kind of coke. As to this, it may be mentioned that the coke made in these ovens is spoken of as being superior for blast-furnace purposes to that which is made from similar coal in the "beehive" ovens; and also that what is known in the market as "French" coke (from its being made in the Simon-Carvès oven) commands a slightly higher price for foundry purposes than coke made from the same coal in ordinary ovens. Much, however, depends upon the quality and purity of the coal used; and there is still some difference of opinion among coke makers as to the merits of externally-fired ovens like the one described. It is certain that, to work the oven system successfully, one must become somewhat of an expert in the manufacture of coke; for this, instead of being a secondary, becomes practically the chief product. Moreover, it must be apparent that the system can be employed to most advantage in the neighbourhood of the chief manufacturing industries requiring a supply of hard coke. Having said this, it must still appear that to ally it to the manufacture of illuminating gas would relieve the market of a proportionate quantity of gas coke, and at the same time arrest the increase in the production of residuals, which must be the inevitable result of its independent growth.

The analysis marked No. 3 in the table was of a sample of the gas after it had passed through the absorber; and it is rather curious that it should show the same percentage of hydrocarbons as No. 2. At the time, however, that this sample was being taken, the illuminating power of the gas was above the average; and, unfortunately, a corresponding sample of the same gas taken from the inlet of the absorber was, owing to an accident, not preserved. This would probably have shown the percentage of benzene, upon which the illuminating power of the gas mainly depends, to be comparatively small. The gas, after having passed through the absorber, gave an illuminating power of only 4 candles when tested at the 5-feet rate, but 12 candles when tested with the chimney fairly full of flame,

and afterwards corrected to 5 feet consumption. Deprived of the benzene, it still remains a very fair heating gas—very suitable, one would think, for many industrial purposes, although inferior to ordinary coal gas, owing to its containing less marsh gas.

It remains to be mentioned that the whole of the analyses and tests referred to in this paper were made by Mr. E. L. Pryce, an Associate of this Institution.

Mr. HUNT said he should like to supplement the paper by one or two remarks. The first had reference to the shorter time of carbonization required by the ovens referred to, and to the stress laid in the paper on the peculiar method of construction—having side flues of separate material. It ought to be stated that something depended on the quality of the coal used, and on the width of the charge. In these ovens, there was a charge from 15 to 16 inches wide; whereas in other ovens, requiring a greater length of time for carbonization, the width was about 20 inches. A few inches in width, as the members knew, would make a considerable difference in the length of time needed for carbonization. With regard to the heating value of the gas, according to the analyses, the Brymbo No. 1 gas gave 583 British thermal units, and No. 2 gave 484 units; while London gas gave 585 units, and Birmingham gas 618 units.

Discussion.

Mr. G. LIVESEY remarked that, being now to a great extent out of practical work, he had very little authority to speak on the question before the meeting. He thought Mr. Hunt was going to tell them how to dispose of their residuals; but the point seemed to be rather how to reduce the quantity produced. He had been much interested in the paper, because it was quite an old story to attempt to utilize the manufacture of oven coke and gas at the same time, but hitherto without success. He believed the main reason had been the large amount of time required to produce the coke. According to the account now given, this time was greatly reduced; and he thought the arrangement described would compare very well with the ordinary retort-house as to the area required for the manufacture of a given quantity of gas. He reckoned that each of the ovens, taking the party walls and the flues, would be about 4 feet wide, or perhaps slightly less; and assuming that they would be placed side by side, 4 feet run of the oven-house would carbonize 4 tons of coal in 24 hours, or a ton per foot run, which was not much less than was obtained in the best retort-houses now built. In a setting even of ten retorts, they did not get much more than a ton per foot run; so that one great objection which had occurred to him as to the use of this method for gas-making purposes was removed. He quite agreed with Mr. Hunt that it was advisable to get rid of the surplus production of residuals; but, unfortunately, they must make these things. It was not like an ordinary business, where, if the market were overstocked, one could cease manufacturing. But gas being always required, they must make residuals, whether they liked it or not, with the consequence of seriously glutting the market. The hard coke, however, would only have a limited market. In many towns, the oven-coke would be of no use at all; and it would then have to be sent to places like Birmingham, where perhaps it would not be welcomed very heartily, and so intensify the evil which was now complained of. The transfer of coke from one district to another would benefit the railway companies, but no one else, as far as he could see. There had been no revolution hitherto in the method of carbonizing. The same system was in vogue now which was introduced with the first gas-works ever erected—viz., that of carbonizing in closed retorts. Minor improvements had, no doubt, been introduced, but no radical alteration had taken place; and if by some such means as those described in the paper they could supplement their ordinary manufacture, and thus be able to meet the difficulty of dealing with coke, tar, and ammonia, it would be a great advantage.

Mr. G. C. TREWBY (London) said the author had not stated the quantity of bisulphide of carbon given off by the coal carbonized in the way described, which he (Mr. Trewby) should imagine would be very large. He remembered some years ago, when he used 18-inch circular retorts, which allowed the greatest thickness of coal per charge ever employed, they were very much troubled with the large amount of bisulphide; and having made a number of experiments, he found it was due to the thickness of the charge. As this was increased, there was a larger surface to allow the sulphur to come in contact with the small coal, and by this means to get a considerable amount of bisulphide. He should personally go rather in the direction foreshadowed in the President's address—in the carbonization of coal in the form of dust. Some of the members might have seen an appliance introduced by Mr. Bryan Donkin for the purpose of burning small coal under a boiler. This brought to his recollection experiments made a great many years ago with reference to letting small coal down an iron pipe; but it was then found that the coal adhered to the side of the pipe, and soon choked it. It was in the form of an impalpable powder. In view of this difficulty, he did not pursue the experiments. Perhaps, however, the difficulty might be overcome; and theoretically, to his mind, this was the most perfect way of carbonizing coal. He did not see very much in the plan now brought forward. Coke-ovens had been employed by gas companies from time to time; and Mr. Livesey would recollect the old London Company introducing them. They went on until they brought their shares down from about £50 to 50s.; and then they gave the system up. In conclusion, he should like to ask, with regard to the analyses given in the paper of London and Birmingham gases, whether they were the result of one analysis or more, because he had been under the impression that London gas was quite equal to Birmingham.

Mr. G. E. STEVENSON (Manchester) said he had been much interested in the paper; and it struck him that the success achieved, in regard to the quality of the gas, the quantity of the residuals, and the time expended, was very much in proportion to the approximation of the system to the ordinary method of carbonizing in use in gas-works. That there was such an approximation was very evident. The designers of the ovens described had purposely gone in the direction of carbonizing coal in comparatively thin layers; but instead of taking the thinness of the layer vertically, and spreading the coal out over a flat horizontal surface an inch thick, they reversed the order, and made the thinness of the layer to be horizontal, and the depth vertical. The arrangement of flues seemed very ingenious; and it was evident that the same principle of carbonization was going on as was adopted in ordinary retorts. Another point of interest was the idea suggested of internal firing in the retorts themselves. The internal flues, which could be taken down and replaced when worn out, seemed very suggestive. One had there the means of applying the heating gas in actual direct contact with the coal by inserting flues; and he thought this would lend itself very easily to the adoption of such a system. They might build up a system of ovens of any size, having flues among the coal, and so dividing it up into portions of limited thickness; and thus, while carbonizing the coal apparently in mass, they would actually do it in divided portions. It occurred to him that there might be a difficulty, however, if the system came to be largely developed, from an infiltration of producer gases into the gas. Looking at the analyses, he thought there was a considerable proportion of carbon monoxide present; and he suggested whether this might not be due to some extent to this cause. He thought it would be almost impossible to maintain the flues absolutely gas-tight. If the oven were under pressure, the reverse of this would occur; and there would be a loss of gas through the flues. On the contrary, if a vacuum existed by the pull of the exhauster, there would be an infiltration of producer gas. This happened in retorts now; and possibly the same influences which closed up the cracks of retorts, and made them practically gas-tight, might act in a similar way with the kind of flues referred to in the paper. What Mr. Livesey had already mentioned had also occurred to himself—viz., the approximation in point of time, in carbonizing a certain weight of coal, to that which was usual in ordinary gas-works, and also the amount of work capable of being done on a certain area. This was not only surprising, but very suggestive and encouraging.

Mr. J. YOUNG (Etruria) said he took it that Mr. Hunt had brought this subject forward to see if the members viewed it, as he did, as a possible ally in the manufacture of coal gas. It still remained, however, to be shown that ovens could be economically heated with producer gas made from coke or inferior coal. If this could be done as an assistance in gas production, these ovens would be valuable; but if not, the whole, or nearly the whole, of

the gas produced would be required for heating the ovens themselves. If they could be heated by some inferior fuel, it might be possible to do away with gasholders almost entirely. Supposing the installation of coke-ovens to be equal to the maximum output, in the summer time they would only purify a sufficient quantity of the gas made to meet the demands of the consumers, so that large storage capacity would be unnecessary; and in the winter the whole maximum output would be used, and the ovens would be heated by the inferior gas. It had been shown conclusively that very fair gas could be made; and he thought, from his own knowledge that, by enriching it, it might be a very useful ally indeed. On the other side of the Atlantic, a large Company had been formed to provide fuel gas on this system. No holders were put up; but there was an installation of coke-ovens sufficient to more than meet the likely maximum demand. He did not know that it was contemplated to use the gas for illuminating purposes; but this might probably be done in the future.

Mr. S. Meunier (Stockport) remarked that there was one important point in the paper which had not yet been referred to. It was stated that the production of crystalline sodium ferrocyanide when coal was carbonized under moderate heats of from 1500° to 1600° was only about ½ lb.; whereas by raising the heats to about 1700°, the amount increased very materially—from 3½ lbs. to 6 lbs. He should like to have Mr. Hunt's opinion as to which method of working he would advocate, because it appeared, according to the present prices of residuals, that the production of this ferrocyanide was preferable to the production of so much ammonia. He noticed that farther on the quantity of 10-oz. liquor worked out with moderate heats to 40 gallons, which was certainly very high. If this were carried on all over the country, it would bring the price of sulphate down even lower than it was at present. He noticed one advantage of the coke-ovens described, that the charging was very easy; and it might obviate a great deal of difficulty with regard to the present method of using machinery. Like previous speakers, he had been struck with the space occupied and the amount of work done. When he first looked at the oven, he anticipated that the quantity of coal carbonized would be very much less than it was under the present system; but when he came to compare it, he found there was very little difference. With an ordinary retort-house, the capacity per ton of coal carbonized was about 36 cubic feet; whereas with the system before them, it worked out to about 41·28 cubic feet. It might be an advantage to carbonize coal in this way; but he could not quite see how they were going to reduce the production of residuals, when he noticed that eight months' working of the ovens showed an average yield per ton of nearly 14 cwt. of coke—foundry coke, not gas coke—and 28 lbs. of sulphate of ammonia.

Mr. Lewis T. Wright (London) stated that, some time ago, a gentleman connected with the Brymbo installation drew his attention to the results obtained there; and it occurred to him (Mr. Wright) that, if these could be supported by any engineers competent in such matters, it would be of very great importance. They were therefore very much indebted to Mr. Hunt for bringing the matter forward and confirming the results, so that they were warranted in giving further attention to the subject. It must be evident that in the Brymbo ovens they had practically as good a gas as was obtained in retorts. There might be other reasons also why the gas industry should pay attention to what he might fairly call "exotic" methods in carbonization. Ever since the commencement of operations, the endeavour had been to escape from a piecemeal system; and there the coal was carbonized in mass, apparently giving gas of the same value as that they usually obtained. It might be said that they had necessarily to make gas, and other things came in, whether they wanted them or not. But there was a certain demand for coke; and it had to be met. Gas coke was not a substitute for oven coke; and in making the latter coke, these other things must be produced. Thus the industry was brought into competition with the forced production of a number of residual products which competed with gas makers; and it seemed to him therefore that this matter was well worthy the attention of gas engineers. If they could carbonize their coal, or a portion of it, in the way described, they would be able to produce the coke, and sell it as such; and this would diminish the amount of tar, ammonia, and other things they had to dispose of. He said that, in his experience, the highest production of gas had been accompanied by the largest yield of tar and ammoniacal liquor; but this was not his experience in connection with tar. He believed that, in the case of every organic substance which was destructively distilled, as the temperature was increased, the yield of tar was diminished. Whether or not ammoniacal liquor in this case simply meant water containing so much of something else, he did not know; but if it simply referred to ammonia, he thought that statement also was likely to be a little misleading, because, when they passed a certain temperature in the carbonization of coal, the ammonia was reduced. This was confirmed by what the author said in his paper—that cyanogen was a high-temperature product. It was stated that it could hardly be without consequence that the smallest yield of cyanogen was accompanied by a very abundant yield of ammonia; so that, if cyanogen was a high-temperature product, it would appear that ammonia was not a high-temperature product, but, on the contrary, reached its maximum when the temperature was moderate. Again with regard to nitrogen. In gas analysis, this matter was of some importance; but it had been very much misunderstood. One sometimes saw analyses showing an amount of nitrogen which one knew, under the circumstances, was not at all possible. An analysis which gave absolutely no nitrogen had much the same effect on him as one that showed 10 or 12 per cent. For instance, there was one in the table which gave no nitrogen in certain samples of gas from the Brymbo works; and against this was put, for the purpose of comparison, certain analyses of London and Birmingham gas. It was stated in the paper that the reason for the absence of nitrogen in the case of the Brymbo gas was because they were working at a slight pressure. This might be interpreted that the reason for the presence of nitrogen in the cases of London and Birmingham gas was because there was a slight vacuum; the inference being that the nitrogen was obtained from the air. The question whether or not nitrogen was drawn in by the vacuum was very material. As a matter of fact, little importance should be attached to the percentage of nitrogen shown in gas analyses, unless they knew it had been made, he would not say by competent people because, of course, all gas engineers were competent, but by methods which were capable of showing, for instance, whether or not there was any nitrogen. Unless gas analyses were conducted on certain lines, the quantity of nitrogen shown would be rather delusive.

Mr. J. Methven (Beckton) asked if Mr. Hunt would state the quality of coal used at the Brymbo works. He (Mr. Methven) also had been struck by the large amount of ammoniacal liquor—40 gallons of 10-oz. strength per ton. It seemed rather excessive, unless they happened to know that the coal was derived from the Midland district.

Mr. Hunt: That is so.

Mr. Methven said it was important to have this stated, or critics in the South would be finding fault with some of them for only producing 30 gallons, which was as much as was made in London.

Mr. T. Holgate (Halifax) said he noticed that the length of the retorts was about 32 feet; and the cross-section at the discharging end was 16 inches, as against 15 inches at the inlet. He should like to know whether any difficulty was experienced in discharging these ovens with so very small an amount of tapering. If so, it would be very probable that the joints of the flues might be opened; and in this way access would be gained to the oven from the flue. Possibly the author could inform them as to the comparative cost of these ovens, and the expense of maintenance in comparison with ordinary retorts.

Mr. A. Edwards (Taunton) said nothing was stated in the paper as to the proportion of gas that would be used for heating the retorts, assuming it to be derived from outside sources; and one could not make a balance-sheet of this method without knowing to some extent how much fuel was required. It was said that 14 cwt. of coke was the production per ton; but this was the result of the use of some portion of the gas itself for the purpose of carbonization.

Mr. W. King (Liverpool) said they all knew "Punch's" advice to those about to marry; and when he saw the title of Mr. Hunt's paper on residuals, he rather hoped that the author was going to tell the members how they were not to get any at all. They were at present suffering from the miserable price of residuals; and they would therefore

welcome any process which would reduce the production of ammonia. He believed Mr. Hunt himself was erecting a carburetted water-gas apparatus which was to a very large extent to enable him to use more of his bye-products; and certainly the Institution would welcome any process which would make them self-contained. In the present circumstances, the ideal state of things would be to have no residuals to dispose of, so that they would not have to go to outside markets to get rid of their products, which at present caused a great deal of anxiety. Though this ideal state of things was not put before them in the paper, they were much indebted to Mr. Hunt for having introduced the subject.

Mr. R. O. Paterson (Cheltenham) said it had crossed his mind that possibly gas managers were not altogether in sympathy with Mr. Hunt's apparent object, as set forth in his paper; but there was no doubt that they did require a little spur, and if possible to get into fresh lines of work. He felt convinced that their best efforts should be devoted to obtain the largest quantity of gas from the coal used, and let the residuals look after themselves. They could not, of course, make gas without having residuals; but if the first object were to get the largest possible bulk of gas from coal, they would, of course, lessen the quantity of raw material required, and to this extent reduce the quantity of residual products put on the market, and thus help to raise the price. If they were all in the neighbourhood of manufacturing towns, they need not altogether despair about the future; but he could not see what benefit gas companies or local authorities would derive from the adoption of such a process as this. On the other hand, if there was an improvement in gas making such as the President had referred to in his address, by which they could get a very large supply of gas from a small quantity of coal, they would benefit considerably. The most noteworthy part of the paper was, he thought, that which referred to the question of the cyanogen. It was a very important matter, and one which was likely to form the principal feature of discussion this year. The system was, he understood, capable of being adapted to works of any magnitude, where sufficiently high heats were used.

Mr. A. F. Browne (Rotherhithe) said this matter was very interesting to himself; and he believed it had been for a considerable time more or less in the minds of a good many gas engineers. The suggestion was started in the "Journal of Gas Lighting" some time ago; and it led to a discussion. Looking at the method of charging, it appeared to him to be simplicity itself; and the way in which the coke was removed also seemed simple enough, though a question had been asked as to whether or not it would have any effect on the stability of the sides of the chambers, leading to infiltration of producer gas. It was evident that the quantity of gas produced per ton of coal was very fair, considering the kind employed. The illuminating power was astonishingly high—15·2 candles. If this might be taken to be a fair average when the exhauster was not playing tricks, it was a surprisingly good result; because, though it had been pointed out by Mr. Stevenson that the same principle was aimed at in these chambers as in ordinary retorts (of carbonizing coal in thin layers), it made a very great deal of difference indeed when the thin layer was vertical, and not horizontal. He understood that there was one exit-pipe for the gases, which was placed at the top; and consequently the gas made in the coal at the bottom had, somehow or other, to get through the whole depth of that coal before it could reach the exit. Whether it passed through the coal, or whether, owing to the shrinkage, it passed between the coal and the sides, it must be exposed to a considerable amount of scrubbing over the heated surface of the incandescent coke; and therefore it was a matter of astonishment to him that the illuminating power should be 15·2 candles. He should be glad if Mr. Hunt could give any figures as to the cost per ton by this method. Perhaps they were not forthcoming from those who had worked the apparatus. Their thanks were, however, certainly due to them for having gone so far as to put in a station meter; and they might perhaps give the further information which was so desirable. Though the residual products were greatly reduced, a considerable quantity remained. He understood that 15 per cent. must be deducted from the figures; but that would still leave 11½ cwt. of coke, 7½ gallons of tar, and a very small amount of sulphate. Altogether, it appeared to him that economy must be effected by carbonizing coal in bulk in this manner, without such losses as they might reasonably have expected to be the case. He should also be glad if they could be informed as to the cost of washing and crushing the coal. He noticed by the analyses that the amount of carbonic acid was rather excessive, and the sulphuretted hydrogen very low; so he had no doubt whatever that the difficulties of sulphur purification would be very considerably increased—to such an extent, in fact, that the expense of purification might be doubled.

Mr. C. Meiklejohn (Rugby) asked if Mr. Hunt could give any information with regard to Mond's producer ovens. A gentleman had lately called upon him who had been present at a meeting where Mr. Mond read a paper on the producer ovens in use at the Brunner-Mond works, and stated that by this process 100 lbs. of sulphate of ammonia were made per ton of fuel. There was one peculiarity about it which illustrated the point raised by some of the speakers with regard to lower temperatures facilitating the production of ammonia. In this particular producer, which held 2½ tons, a quantity of steam sent through the furnaces was more easily used, and the surplus was afterwards condensed; the effect being that the temperature of the exit gases from the producer came down so low that it prevented the splitting up of the ammonia, which was lost in other cases. If this producer were largely adopted, he was afraid Mr. King would have to deplore the use of this method of carbonizing, so far as the production of residuals and the larger yield of sulphate were concerned; and this would be very hard on those engaged in coal gas manufacture.

The President said he had read the paper with very considerable interest; and there was really a great deal of matter in it well worthy of attention. He could not at all agree that it should be their duty to reduce the quantity of residuals to the lowest possible limits. If gas makers were now the only producers of ammonia and the other residuals they dealt in, they might probably, by reducing the quantity made, keep up a sort of inflated value for these products; but the only reason they were not at the present moment being produced in enormously greater quantities was simply because the price was not sufficiently high. In the case of ammonia, and probably in that of the other residuals, gas-works would gradually have a less dominating influence in determining their price. His own impression was very strong that the only method by which gas makers would be recouped for the loss sustained by recent reductions in price, which they might look upon as pretty permanent, was by endeavouring to increase the quantity produced—in fact, to take as much as they could out of the material they had to deal with. On this point he was probably not in accord with the general feeling; but that was his own strong conviction.

The midday adjournment here took place. On resuming,

Mr. Hunt, in reply, said he hardly expected that this now old subject, which had occupied the bulk of the paper, would be received with much enthusiasm; and he was greatly gratified at the reception it had met with. He would endeavour to answer, as far as he could, the questions which had been put. With regard to the cost of washing and crushing, speaking from memory, he thought it was about 3d. per ton. He could not give the cost per ton of coal carbonized, though he had the figures supplied to him at the colliery, because circumstances varied so in different localities, that they would be of comparatively little value. He therefore preferred to rely on the facility with which each operation was performed. There was no skilled labour required. The coal was simply dropped in; and the only man who could be called a mechanic was the one who drove the steam-ram. As far as he (Mr. Hunt) observed, there was no difficulty whatever in discharging the coke. The ram was put into operation, and the coke slipped out of the oven in a solid wall for several feet, and then began to part—falling both ways on to the coke-level. The discharge of four or five tons was effected in less than two minutes. It was evident that it did not injure the sides of the oven, for there was no sign of any great excess of carbonic acid or of nitrogen in the gas. He attributed the large quantity of nitrogen shown in the analysis to the excessive pull of the exhausters, and the ends of the ovens being improperly luted. As regarded the capital outlay, he had the figures of the cost of the ovens at Brymbo; but they included the residual plant, and therefore they would hardly be a guide. It was certain, how-

ever, that the cost per ton of coal must be less for this system than for the ordinary one; and it was also proved by experience that the cost of maintenance was less. These ovens had been working for ten or twelve years with very slight repairs. The proportion of gas used for fuel he had hoped to give in the paper; but he was not able to do so. He was satisfied, however, that the quantity available for other purposes was considerable. It had been reckoned that in one kind of ovens they took from three-fifths to four-fifths of the gas to heat them; but in the type before them, it was considerably less than that. He could not speak with confidence on this point without having the actual figures. The only data he had at present as to the quantity of coke which might be required to heat the ovens, was that supplied when the ovens were heated up for the first time when gas was made, when, of course, they would have to be heated with solid fuel; and it was estimated that about 25 per cent. of coke would be required for the purpose. But this again was a matter which he was anxious to inquire into further. Mr. Stevenson's objection to the infiltration of furnace gases from the flues was answered by the fact that there was very small evidence of it in the analysis of the gas. Mr. Meunier asked whether he (Mr. Hunt) recommended high or moderate heats. He had already stated that, as far as his experience went, moderate heats gave better all-round results; and if the object was to get as much as possible from the coal by way of gas and residuals, moderate heats paid in the long run better than high heats. The idea seemed to be rather prevalent that, in suggesting this method of carbonizing, he was aiming at a reduction in the quantity of residuals made; but this was not correct. He advocated getting as much out of the coal as practicable. The points of the paper were that on the Continent there were many thousands of these ovens at work, producing residuals as well as gas; that this production had already had a very marked effect on the price of residuals; that the gas-works could no longer control the price; that everyone was aiming to make them; and that the system must inevitably extend in England, and had already done so to some extent. This meant more residuals being made, which would come in competition with their own. If this system were worth adopting as an ally, they would come into the market as sellers of hard coke, which would prevent a certain amount of such coke and residuals being made elsewhere, and reduce the quantity they produced themselves by the ordinary method. If these residuals were to be made, they had better make them than let other people do so. Mr. Livesey seemed to think that it would rather accentuate the present difficulty experienced with regard to coke made in other localities coming into competition; but he (Mr. Hunt) did not see the matter in that light. Take the case of a manufacturing town where a certain amount of hard coke was imported. If these ovens were adopted, the coke would come into competition with the hard coke brought from a distance, and would be sold in the immediate neighbourhood, with a reduction in the quantity of both gas coke and hard coke. They could not control the quantity of hard coke—it was made as it was wanted from year to year. If gas-works produced it, other makers would be shut out. They would simply buy the slack and make hard coke, instead of its being made elsewhere. He was sorry he could not answer Mr. Trewby's question as to the quantity of bisulphide of carbon in the gas. He had arranged for the tests to include this point; but unfortunately, owing to a misunderstanding, it was not done. Still, the purification from bisulphide of carbon was not such a difficult matter now as it would have been regarded some years ago; and he should not be at all staggered if they found a large increase, though he did not know why they should. He did not find any reduction in the illuminating power owing to the gas passing through this depth of coal; and he did not see, therefore, why the bisulphide of carbon should increase. Even if there was an increase of 50 per cent., he did not think it would add materially to the cost of purification. Mr. Trewby was also rather doubtful as to the success of the process, having regard to certain experiments which were tried some forty or fifty years ago. But if they were to depend on experiments half-a-century old, the world would have to stand still. He had shown that, according to the experiments made, the illuminating power could scarcely be said to have suffered—certainly not very materially. Part of the coal used was very good gas coal; but it was mixed with some inferior steam coal, which, if employed alone, would only yield about 13-candle gas. Mr. Trewby had referred to the analyses of London and Birmingham gas. Both of these were an average of two or three. He did not get them for the purpose of comparing London and Birmingham gas; but Mr. Trewby would find that the Birmingham gas was the better. It contained 4·9 per cent. of hydrocarbons, as against 4·7 per cent. in the London gas, which was of some importance considering the benzene; and it contained also less hydrogen and more marsh gas. He had only brought the experiments relating to these ovens before the meeting because he had none with regard to other forms of oven, and not because he had any interest, either direct or indirect, in this particular form. The object of the paper had been to call attention to the possibility of a new method of carbonizing for gas making which should, in a measure, relieve gas undertakings from the embarrassment which they now felt with regard to residuals, and which must continue to exist as time went on. He understood Mr. Wright to object to any tests which did not show some nitrogen. He had anticipated such an observation; but he had already stated that the experiments were made by Mr. Pryce; and they appeared in the Transactions of the Institution. They were all taken by the same method; and he had asked Mr. Pryce to furnish him with a note of the method employed. This he would read. A quantity of gas, after the absorption of carbonic acid and oxygen, and unsaturated hydrocarbons, was taken, mixed with a large excess of air, and exploded. The carbonic acid and excess of oxygen were then absorbed, when the nitrogen alone remained, equal to that contained in the quantity of gas used. In many cases, he found that gas, even when produced at a high temperature, did not contain any nitrogen; the residual nitrogen left after explosion being no more than the volume of nitrogen in the air which was mixed with the gas before exploding. He added that his work led him to doubt whether any but the merest trace of nitrogen in coal gas had its origin in the coal used; its presence being probably almost entirely due to admixture with air.

The PRESIDENT asked if Mr. Wright desired to add anything on this last point.

Mr. WRIGHT replied that he should like to make one or two observations on the question of nitrogen. As an absolute natural fact, it would be difficult for anybody acquainted with the changes that took place in the distillation of coal to believe that it was possible, when coal was distilled at a moderately high temperature, to have a gas absolutely free from nitrogen. With regard to the method of testing, he knew it was the common method; but all the errors, whatever they might be, were thrown on the residual gas, which in the case of coal gas analysis would, of course, be nitrogen. In this particular instance, too, air had been used as the exploding agent, in place of pure oxygen, which was sometimes employed; and consequently an amount of nitrogen had been added to the gas. It therefore appeared to him that there was an additional source of error introduced in the form of the air added; and thus the chances of mistake were rather magnified than lessened.

EFFICIENCY OF THE LONDON ARGAND AT DIFFERENT RATES OF GAS CONSUMPTION,

WITH SPECIAL REFERENCE TO ITS USE AS A GAS-TESTING BURNER.

By LEWIS T. WRIGHT.

That the amount of light yielded by unit volume of an illuminating gas, when being consumed in a "London" argand burner, varies with the quantity of that gas being consumed in a given time—or, in other words, that the efficiency of the burner depends upon the rate of gas consumption—has been generally known; but the author is not aware that the burner in question has been submitted to a critical study.

In 1870, Mr. R. H. Patterson, then one of the London Gas Referees, investigated the behaviour of London coal gas in this burner; and in his article "On Gas-Burners and the Principles of Gas Illumination," to be found in Vol. III. of "King's Treatise on Coal Gas," he showed how much the light developed per unit volume

of coal gas was affected by the rate of its consumption, and he explained (p. 84) that the maximum air supply was pretty nearly fixed by the chimney, and that by increasing the gas supply till the flame was about to smoke, the defect of over air supply, observed with low rates of gas consumption, could be remedied, and the maximum efficiency obtained. He stated, as an absolute rule for argands, that they give the maximum yield of light per cubic foot of gas just at that rate of consumption when they are about to smoke. In the author's experience, this rule has not been found to be universally true. It certainly is not true for cannel gases of from 22 candles upwards, nor of safe application to common coal gas benzolized up to 16 candles or thereabouts, nor for common coal gas enriched with gasoline up to 18¾ candles.

It is hardly necessary, in the limits of this paper, to discuss in detail the manner in which the relation between the air supply and gas supply varies with the rate of gas consumption. The air supply is a function of the temperature generated within the chimney; and this, in its turn, depends upon the mass and quality of the combustible material being consumed in a certain time. If there were no resistance to the passage of the air by friction, the air current would by no means increase in direct proportion with the temperature, but only as the square root. Thus, if the temperature could be doubled by doubling the amount of combustible material consumed, then the air supply (ignoring friction) would only be increased about 40 per cent. Friction there is; and this increases probably as the square of the velocity of the air current.

On theoretical grounds, the air supply by no means increases in simple proportion with an increase in the consumption of gas within the chimney. At low rates of gas consumption, the air supply is in excess, and the luminous portion of the flame is relatively white; as the gas consumption increases, the air supply is less in excess, and the luminous portion of the flame becomes yellower; and finally, when the gas consumption has increased to such a point that the air supply is deficient, the flame becomes lurid and smokes.

The efficiency of a unit volume of the gas during this change in the rate of consumption has been increasing up to a certain maximum at a point somewhere less than that at which the air supply may be said to be deficient, from the point of view of smoke. After the point of maximum efficiency—which is more or less near to the smoking-point, according to the composition of the gas—is reached, the further increase in the consumption of gas, which may not necessarily be attended with smoke, is accompanied with a lowering of the efficiency. This fall in the efficiency curve is important, as it happens that there are often two rates of gas consumption that will with many gases produce the same flame value. It is especially important in reference to a recommendation of the Photometric Standards Committee, "to allow the Gas Referees to sanction a mode of testing in which the gas shall be burned from the standard 'London' argand burner at whatever rate is found requisite in order that it may give a light equal to that of the prescribed number of candles." The wording of this recommendation requires amendment; and for "whatever rate" it would be safer to substitute "the lowest rate," since there might be two rates, one on each side of the point of maximum efficiency, which would give the prescribed number of candles.

The question of the efficiency of the standard "London" argand at various rates of gas consumption, and with gases of different qualities and composition, is worthy of discussion from several standpoints.

1.—*From the point of view of official gas testing as at present practised, either under the terms of the Gas-Works Clauses Act, 1871, or under the Instructions of the London Gas Referees.* For the sake of illustrating the bearing of the varying efficiency of the burner on this question of official gas testing, the author will cite the case of a gas that, if tested under such circumstances of pressure and temperature as are represented by a tabular number of 1·000, would give a light of 16 candles at the measured rate of 5 cubic feet per hour. If the conditions of temperature and pressure were changed, so that the mass in the measured rate of 5 cubic feet per hour became only 96 per cent. of what it would be if measured under standard conditions, the quantity of the combustible material is not only 4 per cent. less, but the efficiency of the burner may be so decreased that the light will be not 4, but 6 or 7 per cent. less. In a case cited by the author at the last meeting of this Institution, the light yielded was only 15 candles.* The standard volume was, however, only 4·8 cubic feet; and under the Instructions of the London Gas Referees, the illuminating power would, after correction to standard conditions, have been recorded as 15·6 candles.

Under the Gas-Works Clauses Act, 1871, it has been decided by Magistrates that, as there is no mention in the Act of a correction for variations of conditions of temperature and pressure from standard conditions, no such correction can be applied. The true 16-candle gas might be, therefore, with tabular number 0·960, reported as 15 candles under the Gas-Works Clauses Act, and 15·6 candles under the Instructions of the London Gas Referees, or even less. On the other hand, if the conditions of pressure and temperature were represented by a tabular number of 1·020, the gas might, under the Instructions of the London Gas Referees, appear as 16·6 candles, and under the Gas-Works Clauses Act as 17 candles.

The application of a correction to bring the volume of gas consumed to standard conditions, adjusts differences due to variations in pressure and temperature, but it does not touch variations in the efficiency of the argand burner at various rates of consumption.

2.—*From the point of view of the desire of some authorities to test the gas under those conditions that will consume it in the burner at the maximum efficiency.* This has been stated by Mr. Patterson as an absolute rule, for argands to be at the point when any further supply of gas would produce smoking. The principle, though very often true for ordinary qualities of 16-candle coal gas and less, is not always so; and the author has encountered very many exceptions. Since the point when any further gas consumption will produce smoke is not necessarily that of maximum efficiency, by what means can that desired point be found? To prescribe that the chimney shall be full of flame is not practicable, as with some gases it might, if literally carried out, produce a flame manifestly smoky. It is possible to prescribe that the flame shall be such that any further increase in the gas consumption shall cause it to "tail" or "fork" above the chimney; but this point may or may not be the point of maximum efficiency.

Though these questions at first affect London gas alone, it cannot but be believed that any practice adopted in the Metropolis as a standard method or system of photometry would later be generally accepted, not only for official gas testing, but also as a practice in investigations and inquiries of a scientific nature. To prescribe, therefore, that the gas shall be tested at the consumption of maximum efficiency, would, failing some criterion by which this point could be easily defined, be impracticable. While searching for the point of maximum efficiency, the gas supply might be continually changing; and the conscientious gas tester might never find it. To prescribe that it shall be tested with the chimney full of gas, is a condition that, if literally carried out, would often be very prejudicial to the gas.

3.—*From the point of view of those who would test the gas at some standard height of flame.* This proposal the author considers impracticable, as the end of an argand flame is ragged; and two persons might quite conscientiously differ very much as to what might be the true height of an argand flame.

4.—*From the point of view of those who propose to test the gas at a constant flame-value of* (*say*) 16 *candles.* This proposal is only practicable if some invariable standard of light can be found, by comparison with which, at any time and place, the required flame-value can be obtained. The 10-candle Dibdin standard is reported as providing this means of finding a flame-value.

It is interesting to know whether, at any determined flame-value (say, that of 16 candles), the "London" argand burner will be developing the maximum efficiency from the gas, or, if not, what percentage of the maximum efficiency is developed. The question whether the Dibdin 10-candle standard provides a means by which a constant flame-value can be found at any time and place, comes, it is believed, within the scope of this paper; and the author, for that reason, gives an account of some experiments he has made with the new standard.

In some recent experiments on burner efficiencies at various rates of gas consumption, the author has made use

* See "JOURNAL," Vol. LXV., p. 1063.

of the Dibdin 10-candle standard of light. This standard is based on a principle that many could not *a priori* accept —viz., that the light exposed by the 2·15-inch screen is constant, whether the pentane be carried in air or coal gas, and within wide limits—both as to degree of pentane saturation and in height of flame, varying between 2½ and 5 inches.

It may be mentioned that in every case when the standards were fed directly from the carburettors the flames required constant attention in order to maintain them at their normal height. This variation is believed not to be due to changes in the pressure of the gasholder delivering the air. This frequent adjustment of the flame, which, in the author's experience, is necessary to maintain the light constant, is disturbing, and really requires the services of an assistant.

It was found, by carburetting the gas or air into a test gasholder, and feeding the standards from this, that flames of constant height could be maintained. It was discovered that the pentane gas or pentane air so prepared differed more or less widely from the product obtained by directly feeding the flames from the carburettors. The intensities of the flames were also different. These variations are attributed to differences both in the degree of pentane saturation and in the behaviour of gas and air as a carrier.

The author did not concern himself with the verification of the value of the light passing the 2·15-inch screen in terms of standard sperm candles, but accepted either one or other of the standards compared as being 10 candles. The standards answered the specification.

It was decided to ascertain (*a*) whether coal gas was the equivalent of air as a carrier; (*b*) whether the light was influenced by the temperature of the carburettor; (*c*) whether the light was influenced by the height of flame in the burner. It was determined to adhere in these trials to the principle of not comparing the standards against some other source of light which *primâ facie* might be said to be less constant than a 10-candle standard, as all variations might then have been attributed to this other source of light. In all the trials on the behaviour of the standards, one was compared with another. In that case any variation must proceed from one or other or both of the standards.

Sensitiveness of Eyes and Disc.

Experiments were made at various times to ascertain over what range one of the lights might be moved without producing any perceptible alteration in the equality of illumination of the two sides of the disc. It was found generally that, with one 10-candle standard, with carefully adjusted and steady flame placed on the 1·6-candle mark of an Evans photometer (16 candles), and with another 10-candle standard with equally steady flame placed on the other side, the range over which it could be moved without disturbing the apparent equal illumination was 0·3 of a candle. This was the extent of the neutral range within which no difference in the illumination of the disc could be perceived.

In practice, it was found, on inspecting a large number of tests of ten observations (five on either side of the disc), that there was an extreme difference of 0·30 of a candle, while the least extreme difference was 0·10 of a candle. If the truth were half way between extreme readings, it would appear that any single observation might vary 0·15 of a candle from the truth.

In the case of experiments (averages of ten observations) made in duplicate, with all conditions apparently alike in each of the pair, it was found that the extreme difference between any two of a pair was 0·18 of a candle, and the least difference 0·03 of a candle, with the intensity of illumination in the disc equal to a light of 16 candles 50 inches away, as in the case of the testing of 16-candle gas. While the neutral distance at that intensity is 0·3 of a candle, in practice it appeared to average but 0·22 of a candle—that being the average of a large number of extremes found in sets of five readings. It is therefore not claimed in this paper that phenomenal agreement between single observations, or even between averages of ten (five on either side of disc), can be obtained.

Preliminary trials showed that two standards answering the specification did not agree with each other under all circumstances when the conditions under which each was fed with illuminant were either identical or normal according to the instructions. That is, when both were supplied either direct from their respective carburettors, under the conditions prescribed with air pentane, or when they were both supplied from a common stock of either air pentane or coal-gas pentane, there was a difference; but this difference depended on the sides of the photometer in which they were placed. The photometer was an Evans 100-inch, with stationary disc. Pains were taken to ascertain the cause or causes of this difference in the behaviour of the two standards, but in vain; and the difference could not be mitigated, but remained the same when other conditions were constant.

Experiments Made to Ascertain whether Coal Gas is the Equivalent of Air as a Carrier of the Pentane Vapour.

Series A.—A 10-candle standard, marked "No. 2 N.," being taken as the standard, is placed and kept at the 1·6-candle mark on the left-hand side of the photometer. This is the position the standard would occupy in testing 16-candle gas. This 1·6-candle mark, as well as the one on the other side, and also the pointers on the candle carriages on which the standards were placed, were carefully verified with relation to the middle of the photometer and the disc. Another 10-candle standard, without number, but described in this paper as "S.N.," is placed on the right-hand side, and moved to give equality of illumination on the disc. The carburettors are placed on the table below the photometer. The numbers in brackets represent the order in which the experiments were made. Each result is the average of ten observations (disc and mirrors reversed at the fifth) :—

Left Hand.	*Right Hand.*	Candles.
(1) 2 N. at 16c., fed with air pentane.	S.N. gas pentane. . .	15·30
(2) 2 N. „ „ „	S.N. air pentane . . .	16·12
(3) 2 N. „ „ gas pentane.	S.N. gas pentane. . .	15·79
(4) 2 N. „ „ „	S.N. air pentane . . .	16·38

Gas pentane is better than air pentane in standard S.N. by 0·82 candle (1 and 2). Gas pentane is better than air pentane in standard S.N. by 0·59 candle (3 and 4). Gas pentane is better than air pentane in standard 2 N. by 0·49 candle (1 and 3). Gas pentane is better than air pentane in standard 2 N. by 0·26 candle (2 and 4). The two standards are not affected by the change from air pentane to gas pentane in an equal manner. The standard S.N. being more sensitive to the change.

Series B.—This series was not made on the same day; and though the coal gas employed was approximately the same as regards candle power, it was not, of course, the same gas. The S.N. standard is, in this series, taken as the standard, and kept at the 1·6-candle mark (16 candles) on the left-hand side of the photometer. The 2 N. standard on the right-hand side is moved :—

Left Hand.	*Right Hand.*	Candles.
(5) S.N. at 16c., fed with gas pentane.	2 N. air pentane . . .	16·48
(2) S.N. „ „ „	2 N. „ . . .	16·36
(6) S.N. „ „ „	2 N. gas pentane . . .	16·58
(3) S.N. „ „ „	2 N. „ . . .	16·63
(1) S.N. „ „ air pentane.	2 N. „ . . .	17·35
(4) S.N. „ „ „	2 N. „ . . .	17·47

The tests (ten observations, disc and mirrors reversed at the fifth) are in duplicate, though the two numbers of the pair were not consecutive, as will be seen by the numbers in brackets. They show that changing from air pentane to gas pentane made the 2 N. standard 0·18 candle (average of duplicate experiments) worse. The change from air pentane to gas pentane made the S.N. standard 0·81 candle worse. The effect is in this series the reverse of that found in series A; but, as in that series, the change is notably more marked on the S.N. standards.

Other trials have convinced the author of this paper that coal gas cannot be accepted as the equivalent of air as a carrier of the pentane vapour.

Experiments as regards Position.

Series C.—Both standards were fed with air pentane directly from carburettors placed on the table below. The reversal in the positions of the standards was confined to the standards which were lifted out of the sockets on the carriages.

Left Hand.	*Right Hand.*
(1) 2 N. at 16 candles.	S.N. 16·00 candles.
(3) 2 N. „ „	S.N. 16·10 „
(2) S.N. „ „	2 N. 17·03 „
(4) S.N. „ „	2 N. 17·25 „

Experiments Nos. 1 and 3 of this series agree closely with experiment No. 2 of series A, the conditions of which are the same. When the positions of the standards

are reversed, and the conditions the same, the divergence is very great—in this case 1·09 candles.

Series D.—The standards were now fed from a stock of air pentane prepared in a 5 cubic feet standard gasholder, by passing air through a carburettor belonging to one of the standards. Each result is the average of ten observations as before.

Left Hand.	*Right Hand.*
(1) 2 N. at 16 candles.	S.N. 15·84 candles.
(3) 2 N. „ „	S.N. 15·81 „
(2) S.N. „ „	2 N. 17·04 „
(4) S.N. „ „	2 N. 17·19 „

The agreement between the members of each pair is considered to be satisfactory. The 2 N. standard was still fed from the same stock of air pentane prepared in the gasholder; but the S.N. standard was then fed with air pentane direct from the carburettor. The result was now—

Left Hand.	*Right Hand.*
(5) S.N. at 16 c. direct from carburettor.	2 N. 15·60 candles.

In carburetting directly to the standard, the passage of the air through the carburettor was much slower than when the stock of air pentane was prepared in the gasholder, and a flame richer in carbon was obtained. The difference in the intensity of the flames from the two qualities of air pentane burning in the S.N. standard is in this case 1·51 candles, and is due to the lowering of the intensity due to increase in the pentane saturation. The difference in value of the standard in this as in other similar cases was accompanied by a difference in the colour of the light discernible, not only by direct observation, but by the colour of the disc.

Series E.—The gasholder was again filled with a fresh stock of air pentane, and the standards were reversed. The readings were now (ten observations)—

Left Hand.	*Right Hand.*
(1) 2 N. at 16 candles.	S.N. at 14·96 candles.

With this mixture, the S.N. standard was 1·04 candles better than the 2 N. The 2 N. was still fed with air pentane from the same stock, and the S.N. was fed with the same stock re-passed through the carburettor at normal speed. The readings were then—

Left Hand.	*Right Hand.*
(2) 2 N. at 16 candles.	S.N. at 15·87 candles.

Re-carburetting the air pentane to the S.N. standard, which presumably would increase the degree of pentane saturation, lowered the light in it 0·91 candle, and at the same time made it yellower.

The carburettor feeding the S.N. standard with the air pentane stock in the gasholders was surrounded with ice to reduce the degree of pentane saturation. The readings were now—

Left Hand.	*Right Hand.*
(3) 2 N. at 16 candles.	S.N. at 15·37 candles.

The ice had presumably reduced the pentane saturation; and the light was thereby increased 0·5 candle.

The standard 2 N. was still fed from the stock in the gasholder precisely as in experiments 1, 2, and 3; but S.N. was now fed with air direct to the carburettor still surrounded with ice. No change was produced, as with the carburettor surrounded with ice it made no difference whether or not the air had been previously carburetted before being passed through the carburettor connected with the S.N. standard. The readings were—

Left Hand.	*Right Hand.*
(4) 2 N. at 16 candles.	S.N. at 15·30 candles.

Experiments to Determine the Influence of the Temperature of the Carburettor on the Intensity of the Flame from a 10-Candle Standard.

Series E.—The standard S.N. was fed from a supply of air pentane stored in a 5 cubic feet gasholder. The standard 2 N. was kept at the 1·6-candle mark on the left hand, and fed with air through the carburettor in accordance with the instructions. The temperature of this carburettor was varied by surrounding it with a bath, the water in which was kept at various temperatures.

Left Hand.	Temperature of Carburettor.	*Right Hand.*
2 N. at 15 candles.	68° Fahr.	S.N. at 15·50 candles.
2 N. „ „	56° „	S.N. at 15·60 „
2 N. „ „	89° „	S.N. at 14·95 „
2 N. „ „	95° „	S.N. at 14·50 „
2 N. „ „	44° „	S.N. at 15·60 „
2 N. „ „	39° „	S.N. at 15·45 „

At 89° and 95° Fahr., the light from the 2 N. standard was seriously depreciated.

Experiments as to Height of Flame in the Standard.

Series F.—In Section VII. of the report of the Photometric Standard Committee, it is stated that Mr. Dibdin found that the luminosity of the portion of the flame exposed by the screen remains constant even under considerable variations in the total heights of the flame; and in his recent paper, read before the Society of Arts,* the inventor of this standard said that between a height of flame of 2·5 and 5 inches there is no perceptible variation in the light from the standards. However, the Secretary of the Committee, in his paper on "The Work of the Photometric Standard Committee," † says that with "extreme variations in the flame, such as could only be obtained with gross carelessness, the variation in the amount of light was but small; and when such variations did take place, the light emitted by the standard was less than 10 candles."

The end of the flame is ragged; and in finding the height, or in adjusting to the 3-inch normal height, the mean, and not the extremes, of the forks is taken as the height of the flame. These forks at the end of the flame are continually altering their position and size. Thus any adjustment of the flame is relative.

The following experiments were made with adjustments 0·3 inch high and low:—

Left Hand. Flame.	*Right Hand.* Flame.
(1) 2 N. at 16 c. 0·3 inch high.	S.N. 0·3 inch low at 15·92 c.
(2) 2 N. „ „ low.	S.N. 0·3 inch high at 15·28 c.
(3) 2 N. „ normal.	S.N. normal at 15·79 c.

In the above, the standards were supplied with gas pentane through the carburettors.

Series G.—In this series, both standards were fed from a stock of air pentane stored in a gasholder, prepared by carburetting air through one of the carburettors.

Left Hand. Flame.	*Right Hand.* Flame.
(1) 2 N. at 16 c. normal.	S.N. normal at 14·96 c.
(2) 2 N. „ 0·3 inch high.	S.N. „ at 14·87 c.
(3) 2 N. „ 0·3 inch low.	S.N. „ at 14·37 c.
(4) 2 N. „ normal.	S.N. 0·3 inch low at 15·20 c.
(5) 2 N. „ „	S.N. 0·3 inch high at 15·08 c.

In this series, the lowering of the flame 0·3 inch in standard 2 N. reduced the light 0·59 candle. Lowering the flame 0·3 inch in standard S.N. reduced the light 0·24 candle. Raising the flame 0·3 inch in 2 N. reduced the light 0·09 candle. Raising the flame in S.N. 0·3 inch reduced the light 0·12 candle.

Other trials made with the standards 50 inches from the disc showed that raising one flame 0·3 inch and lowering the other 0·3 inch produced a difference in the light of 0·6 candle.

The two standards, when fed from the carburettors with air pentane, are nearly equal in a certain position—viz., 2 N. on the left hand and S.N. on the right. This equality is no longer observed when the positions are reversed, with S.N. on the left hand and 2 N. on the right hand. 2 N. would make S.N. appear as 17 to 17·3 candles when S.N. is on the 1·6 mark (16 candles).

That the difference in the behaviour in the standards in different positions is not due to the scale, is as easily proved. It is also apparent at whatever distance the flames may be from the disc within the limits of the scale. It is not due to unequal reflection from the sides of the photometer, as blackened screens were inserted to shut off any possible reflection from this source. It was not due to the glass chimneys. When these two standards were taken to another laboratory and placed on a Letheby photometer, they were nearly equal in both positions; but 2 N. was compared with another standard used with this Letheby photometer, and it was found to be equal in one position, but 0·8 candle better in the other. The two standards, 2 N. and S.N., taken back to the Evans photometer, still behaved as before; but the difference depends somewhat on the class of pentane gas with which they may be fed.

During the experiments described, the author had the advantage of the assistance of an experienced photometrist, who recorded the results of the various experiments, and who was always able to note the changes in the behaviour of the standards that were observed by the author.

As a result of this inquiry, the author concludes: That gas cannot be substituted in these standards as the equivalent

* See *ante*, p. 222.

† See "JOURNAL," Vol. LXV., p. 1027.

of air as a carrier of the pentane vapour. That the light from the standards is seriously affected by variations in the height of the flame; a low flame being more prejudicial than a high one. That the light is seriously affected when the temperature of the carburettor approaches 90° Fahr. That the light varies with the sides of the photometer.

Experimental Methods.

In making determinations at various rates of gas consumption, it is important to bear in mind that, though a photometer may deliver a definite quantity of gas for one complete revolution of the meter-wheel and for one complete revolution of the pointer, yet for fractional parts of a revolution it may not be safe to accept as correct those marked upon the dial; and to avoid the inconvenience of calibrating this, the following method was adopted. The rate is observed by noting the time required for one or more complete revolutions of the meter-hand from point to point. The candles' light observed multiplied by the time in minutes for one complete revolution gives the candles per 5 cubic feet. A meter-wheel does not deliver gas at a uniform speed at different parts of its revolution. To correct this inequality, it is necessary to adjust the photometer governor so that it is nearly closed, and to increase the gas pressure in the inlet of the meter, if necessary, to enable the governor to pass the required quantity of gas.

In making a series of experiments on a sample of gas as regards the light it yields per unit volume at various rates of consumption, it is requisite that it shall be of constant quality throughout the series. To ensure this uniformity, the samples were collected in small gasholders of 5 or 10 cubic feet capacity; and it was easy to ascertain that the gas had remained constant by repeating at the end of the series, or at any interval, experiments at the same flame-value. In no case was any variation observed unless the gas had been carburetted in the laboratory on the inlet of the small gasholder; and then stratification was invariably observed. To remedy this difficulty, it was necessary to churn such samples by drawing the gas off from the top of the gasholder, and passing it in again at the inlet. Without this precaution, the experiments would have been illusory.

In the experiments made on various gases, they were compared on the basis of flame-values by measuring the quantity of gas required to maintain them. The light yielded per unit volume at a 16-candle flame-value is taken as 100, and that at other flame-values in terms of 100. Thus, if a gas, when burned to give a flame of 16 candles, gave a duty of 2·8 candles per cubic foot, and at a flame-value of 10 candles gave but 2·1 candles per cubic foot, it would be said, as regards burner efficiency at the 16-candle flame, to be 100, and at the 10-candle flame to be 75. The yield of light at the 16-candle flame is taken as par.

Table of Burner Efficiencies.

Candle Power of the Gas per 5 Cubic Feet, Calculated from the Yield of Light per Cubic Foot when Tested at the 16-Candle Flame-Value.	Flame-Values in Candles. (In no case were the flames smoking.)								
	10	11	12	13	14	15	16	17	18
(1) 10·80	..	..	..	..	..	95·0	100	105·0	107·5
(2) 11·05	..	..	..	..	92·4	..	100	..	..
(3) 11·30	75·7	..	83·9	..	92·9	..	100	..	106·6
(4) 12·53	..	..	..	..	..	97·0	100	100·8	103·4
(5) 13·43	77·6	..	..	..	93·3	..	100	102·0	..
(6) 13·60	78·9	..	..	..	..	..	100	..	..
(7) 14·08	74·5	..	..	..	94·4	97·7	100	101·9	104·8
(8) 14·08	..	..	..	..	..	97·5	100	100·2	101·2
(8a) 14·24	78·7	..	..	..	..	97·1	100	..	..
(9) 14·30	80·0	..	..	..	95·1	97·2	100	100·3	102·1
(10) 14·49	78·9	..	87·6	..	..	97·9	100	100·3	101·2
(11) 15·40	78·1	..	..	90·4	94·8	97·4	100	101·6	101·6
(12) 15·69	..	..	..	..	94·8	96·8	100	102·9	100·0
(13) *	79·8	83·4	86·9	90·3	93·6	96·8	100	102·8	..
(14) 16·90†	85·8	..	..	..	..	99·7	100	95·9	..
(15) 16·10†	75·8	..	..	..	..	102·3	100	..	..
(16) 16·40‡	83·3	..	..	..	..	98·6	100	100·8 (at 17·4 c.)	96·9
(17) 18·73‡	85·3	..	..	..	98·5	101·9	100	98·6 (at 16·4 c.)	..
(18) 22·00§	85·2	87·5	89·4	94·4	97·5	99·2	100	95·8 (at 16·75 c.)	..
(19) 32·00‖	83·0	..	99·5	..	104·0	102·7	100	..	..

* Average of 16-candle coal gas, tested with candles.
† Coal gas enriched with benzol (C_6H_6).
‡ Coal gas enriched with gasoline.
§ Coal gas and cannel gas mixed.
‖ Cannel gas.

The candle power per 5 cubic feet in the above table is not the candle power if the gas had been tested at that rate, but what it would have been if at that rate it had yielded the same light per unit volume as when tested at the 16-candle flame-value. Had the candle power of the gas been stated at the yield at the 5 cubic feet rate, the lower qualities would, of course, have been very much less.

It will be observed that the loss of light per unit volume between the 16 and 10 candle flame-values increases, though not in a perfectly regular manner, with the poorness of the gas. With coal gas up to nearly 18-candle power, the author had not noticed any case wherein the efficiency at the 15-candle flame-value was higher than at the 16-candle flame-value; and the case of the 16·1-candle coal gas enriched with benzol (No. 15 in the table) struck his attention. The photometric experiments were repeated many times; and in every case it was found to be so. In the case of coal gas enriched up to 18·73 candles (No. 17), the same effect was noticed. It was not so, however, in the case of the 22-candle coal and cannel gas (No. 18).

Smoking Point.

According to Mr. Patterson's maxim, the maximum efficiency per unit volume is, in argands, at the point when any further gas supply would produce smoke. At this point the following flame-values were obtained:—

Candle Power per 5 Cubic Feet Calculated from the Yield per Unit Volume found at the 16-Candle Flame-Value.	Flame-Value. Candles.
11·30	18·00
11·53	16·00
14·05	17·80
14·00	18·00
14·30	18·00
15·40	18·60
16·50	17·00
16·56 enriched with benzol	18·00
16·92 „ „	17·00
17·16 „ „	17·00 (bare)
18·73 „ gasoline	16·40
22·00 coal and cannel gas mixed	16·75
32·00 cannel gas	16·11

The case of the 11·53-candle gas was curious, as the chimney had to be literally filled with flame before it commenced to smoke; and the flame-value was only 16 candles.

This method of finding the point of maximum efficiency would have failed as regards the gases cited in the table of efficiencies in all cases from Nos. 13 to 19 inclusive; but these are cases of either rich gases or gases enriched with benzol or gasoline. The 32-candle cannel gas did not give the slightest signs of smoke at the 16-candle flame-value. It was increased to a flame-value of 16·11 candles before a tendency to smoke was observed; and yet the maximum efficiency was found at the 14-candle flame-value. Mr. Patterson's rule is not contradicted by any of the samples in the table of efficiencies from Nos. 1 to 13 inclusive.

Coal gas, with its various enriching bodies, is a complex material, and when one considers how delicate are the relations between the air and gas supply in the argand burner, it is difficult to hope that any rule of universal application will be found to apply to all its varieties. To prescribe for official testing that the flame shall be adjusted just short of the smoking-point, or that the chimney shall be full of gas (even if such prescriptions could be made sufficiently definite to be safely applied for the purposes of official gas testing), would, it is believed by the author, in some cases be prejudicial to the gas.

As regards testing gas for official purposes at a defined flame-value, that is only practicable if an invariable standard of comparison can be produced under all the conditions likely to arise in practice; and the author is of opinion that, before the Dibdin 10-candle standard can be adopted as providing that invariability, further experience is requisite. It must also not be forgotten that many gases will provide in the "London" argand the same flame-value at two different rates of consumption.

Mr. WRIGHT added that, since his paper had been prepared, he had had opportunities of making experiments with other standards. In the paper he had hardly cared to hazard an explanation of the results; but he might say, not as the result of any experiments actually made which definitely proved the matter, but as a hypothesis which was not contradicted by anything observed, that one standard would not behave in the same manner in two different places. This was a fact which he had observed on many different occasions; and it must be accepted as a fact. He

believed the reason was that argand flames were exceedingly sensitive to exterior air currents. The least disturbance in the air supply would cause the flame to rise above the mark at which it was adjusted, and even to flare in the chimney. He could quite believe that the standard might behave in a particular manner in a position where there were air currents of a certain velocity, and that, on being removed to another site, where the currents might be only feeble, and where the chimney would be supplied with loose air, and where consequently, for the same amount of combustible material going into the chimney, there would not be sufficient air for the flame, it would behave differently. It would then be necessary to reduce the amount of combustible material by adjustment of the micrometer cock. Then if the height of the flame were reduced, and at the same time the amount of the combustible material, how was it possible to have the same intensity of flame-value? He believed this would be found to be the explanation of the abnormality in the behaviour of these standards.

Discussion.

Mr. J. METHVEN (Beckton) said the subject before the meeting was a very interesting one; and the author must have spent a large amount of time and trouble in working it out. Altogether, the results were very useful. It was a matter of some little regret to him that the author, in the examination of the Dibdin standard, had departed so much from the prescription which was issued in the report of the Board of Trade Committee. Though his researches were interesting, they would have been more to the point if he had strictly adhered to these instructions. He (Mr. Methven) had been working with a standard for a considerable time; and though last year he congratulated the Institution on the termination of the labours of the Committee, and then thought that it was a very useful and serviceable standard, twelve months' further experience had somewhat altered his opinion. In the first place, his investigations were directed to ascertain the value in candles of the new standard; and after a considerable number of experiments had been made, he arrived at the conclusion that the nominal value of the standard was 10·282 candles. Now, the Council of the Institution, when they had the pleasure of waiting on the Committee, urged the necessity, when the new standard was introduced, of ascertaining that it was an exact multiple of a sperm candle. But his experiments showed that it was nearly 3 per cent. too high. This was of considerable importance to the London Gas Companies; and it was a matter of regret that the Committee had accepted a standard of such a power. He might mention that the figures he had given were the mean of a considerable number of experiments. After he had ascertained the power of the standard in this way, he commenced to use it in the photometer alternately with candles, to determine the power of the gas he was supplying. But the average of a great many trials showed that the 10-candle Dibdin standard returned the illuminating power of the gas delivered to London 0·8 candle below that shown when using actual candles. These experiments had been made continuously for months; and they were still going on. It was rather a big "pill" for the Gas Companies to swallow, to accept a standard which was going to return their gas 0·8 candle lower than it really was. The question that occurred to him, when he obtained these results, was how it was that in the one case he only had a difference of 3 per cent., whereas in the second case, when testing alternately with candles the gas that was going out to the district, he found a difference, on an average, of 6 per cent. This immediately opened his eyes to what he considered was an error in the whole matter. He believed it to be due to the fact that the centre of the flame occupied the position of the terminal of the photometer. Mr. Harold Dixon, in 1886, pointed out an error (it was only of a temporary character) into which the makers of the screen that bore his (Mr. Methven's) name had fallen. It was considered at that time desirable to make the centre of the flame the terminal of the photometer, instead of the face of the slot immediately in front of the burner. This was the subject of a paper read before the British Association in 1886; and some correspondence ensued in the "JOURNAL OF GAS LIGHTING" upon it,* in which Mr. Harold Dixon pointed out, in a very clear manner, the error into which the makers of the screen had fallen, by substituting the position of the centre of the flame for the face of the screen or the aperture as the terminal of the photometer. It occurred to him (Mr. Methven) that the difference which Mr. Wright pointed out was due to that fact alone; and that, as he altered the position of the different standards which he was observing, the distance of the illuminated disc and the standard varied. Now, he had proved conclusively that the difference to the eye between the 6 per cent. which he found when testing the gas compared with candles was due to the fact that the centre of the flame occupied the position of the terminal of the photometer. It was quite clear that, as the distance increased between the burners and the illuminated disc, so the value of the light decreased upon the disc. This was quite sufficient, to his mind, to account for the difference Mr. Wright had found in the altered position; it was a longer distance on one side than the other. Another series of experiments were made to ascertain the consistency of the 10-candle Dibdin standard. They were told that it was possible to reproduce it whenever they pleased, either in winter or in summer. But his experiments convinced him that it was not possible to produce in summer the same light they obtained from it in winter. This was a highly important matter, and a very serious fault in a standard of light. Within a variation of 22° and 23° of temperature, he found a difference of 13½ per cent. in the amount of light emitted by the Dibdin standard. This range of 22° temperature was not at all excessive, but was often experienced in the official testing-places in London. He started with a temperature of about 57°, and ascended until he sometimes reached 81° or 82°, in the middle of the summer. It was, of course, only rarely that it touched 80°; but 75° and 76° were not at all unusual in the official testing-places in London. This was a great disappointment to him; for they knew that candles varied with the temperature. Sometimes they had a very powerful candle in the winter, and a very poor weak one in the summer; and he had proved this to be due entirely to the effect of aqueous vapour in the atmosphere. He had not the least idea that the results he had found with the Dibdin standard were due to the same cause; and it was a matter of regret to him that the Committee had not thought it desirable to make some correction for the different conditions of the atmosphere. Until the question of aqueous vapour was settled, they would not have a standard that would give the same amount of light at different temperatures. He had hoped to be able to congratulate the Institution on the settlement of this vexed question; but he was bound to say he believed the problem was as far from solution as ever.

Mr. C. HUNT (Birmingham) said he felt rather inclined to recommend the passing of a resolution referring this matter back to the Photometric Standard Committee, with instructions to further consider it. Mr. Methven had just brought a powerful indictment against the new standard; and he (Mr. Hunt) was certainly not in a position to contradict him, not having lately made any experiments on the subject. But he was bound to say that he had been very favourably impressed with the regularity of the standard. While Mr. Methven said that he thought Mr. Wright's objection might be met by conforming to the regulations laid down by the Committee, he (Mr. Hunt) would suggest that Mr. Methven's objection might possibly be met by maintaining a uniform temperature in the testing-room. Therefore, though they might still be some way off a solution of the problem, the means of the solution might not be so remote. He should like to make a remark also with respect to the rate of consumption in the standard burner, in which he was more particularly interested. Mr. Wright objected to this, and said that, under certain conditions, there was no such thing as uniformity to be obtained. He had put upon the blackboard a diagram showing that two rates of consumption might give equal results; and he (Mr. Hunt) could quite follow it where the chord struck the arc in the way shown. But if he had an ordinary case of a chimney full, he might get a result which was below the best, and only equal to that which he obtained at a lower rate of consumption. He was not sure, however, that these points were very practical. Whoever thought of testing 20 or 22 candle gas with the standard argand! He did not believe anyone did; and therefore he thought they should confine their

* See Vol. XLVIII.

attention to the ordinary range of common gas. There was no doubt that gas which was enriched by some carburetting method did not follow the same law as gas made in the ordinary way without enrichment. But, for all practical purposes, he suggested that there was a decided gain and practical uniformity by maintaining, under that test, a common gas at a fairly uniform height of flame in the chimney. He did not suggest that it should be the smoking-point. Mr. Wright had referred to Mr. Paterson's experiments on this matter; but previously to their publication, he (Mr. Hunt) had made a series of experiments, which were recorded in the "JOURNAL OF GAS LIGHTING,"* as to varying heights of flame and chimney. He then came to the conclusion—and he had adhered to it ever since—that the proper way to deal with ordinary gas so as to obtain uniform comparison, was to have, as nearly as practicable, a chimney full of flame. He had seen nothing to upset this view; and he suggested that it would be a great improvement on the proposal of the Standards Committee if this idea were accepted, and a height of flame of 3½ inches, or something like it, were adopted for all qualities of common gas. He hoped, now that the matter seemed so far off settlement, that there might be further time to consider it, and that the Institution would be able to strengthen the hands of their representatives on the Committee, and obtain, after all, better terms for the London Gas Companies, and ultimately for the provincial ones also. He did not know that the time was ripe for any further action by the Institution; but, after what had been heard, it would be *à propos* if a small Committee were formed to consider the subject.

Mr. GEORGE LIVESEY said, as reference had been made to the Board of Trade Committee on Photometric Standards, he might state exactly what the present position was. The Council put in their report a paragraph stating that they regretted that the recommendations contained in the third annual report had not been accepted in their entirety by the Committee. This seemed like passing a modified sort of judgment on the action of the Committee. He saw no objection to the paragraph. It simply meant that the Committee had not adopted the whole of the recommendations. He did not see how they could have adopted them in their entirety, because they were appointed for a special purpose, which was simply to find a better standard in place of the unreliable candle. The only point they went into was a recommendation that, in burning gas, it should not be consumed at a fixed rate of 5 cubic feet per hour, but at such a rate as would give 16-candle power in a "London" argand burner. They were only dealing with London gas; and this was supposed to be the proper standard of light obtainable from the burner. However, the position at present was this: It was all along thought that it would be necessary to obtain an Act of Parliament to carry out the recommendations of the Committee; but the Law Officers of the Crown had been applied to by the Board of Trade for their opinion, which was to the effect that the Gas Referees had power, without any Act of Parliament whatever, to alter the standard or the candle to anything else they considered more suitable for the purpose—that it was in the power of the Referees to prescribe the standard to be used, but not to alter the rate of burning. The London Gas Companies had been written to on the subject, and had been informed that it was the intention of the Referees to alter the standard, but not to do anything in the matter of the rate of burning. On the Committee there were three representatives of the London Gas Companies; and he might say, for his colleagues and himself, that they signed the report as a whole, and would not have signed it if there had not been this recommendation to alter the rate of burning from the fixed 5 cubic feet. Therefore, the position of the London Gas Companies was this: They would not assent, but would offer every opposition—and he felt sure their opposition would be successful—to any alteration, unless it dealt with the matter in a comprehensive manner, as suggested by the report of the Committee. The Board of Trade had been informed of this; and he believed the intention was to introduce a Bill to legalize the alteration in the rate of burning. When the Bill was brought forward, it would be competent for the Institution to make any representation they pleased. They could very well point out that any new legislation which might take place on the subject would not be confined to London, but would be taken as a precedent for the whole of the country; and therefore they would be able to go to the Board of Trade, and say they wanted such and such things. While listening to the discussion, it occurred to him what arrant nonsense the whole thing was. The amount of time that had been spent on this matter, if otherwise occupied, might have had the effect of reducing the price of gas all over the kingdom; and he could not see that they were one atom better off than when he was a youngster, and they used to test the gas in a very crude manner indeed. They employed candles in those days; but they were not bothered with making corrections for temperature, pressure, and all the rest of it. They would just test the gas; and if they found it was about 14 candles, or whatever the standard was, that was quite sufficient; and he was prepared to say the public were just as well served then as they were now. Owing to the institution of the Metropolitan Gas Referees, and all these modern improvements, it cost the public £150,000 to £200,000 more for their gas, for which they received practically no value at all. All this testing was carried to such a refinement of cruelty that it was an intolerable burden on the gas managers, and entailed great expense on the consumers. But the public would have it; and if they were so suspicious of the gas people they must pay for it. He consoled himself with this thought—that, if they were to be bothered in this way, they would have to retard any reduction in the price of gas. So that it would practically have no effect on the gas companies, but the whole cost would be thrown upon the public. He was a determined opponent of all transfers of gas undertakings to public authorities. He thought the holding of gas-works by local authorities was altogether wrong—it was Socialism, and nothing else; and the more he saw of it, the more convinced he was that it was a great mistake. But there was one advantage about it, and it was that, where gas-works were owned by the local authorities, there was no trouble about testing.

Mr. G. C. TREWBY (London) said the paragraph in the Council's report had attracted his attention; and he had had some correspondence with the President upon it, because he felt it was rather a reflection on the Photometric Standard Committee. But as far as the Committee were concerned, they had gone to the extent the Institution Committee had recommended. The Committee recommended that gas should be burnt with a full flame. The 16-candle burner was supposed to be one that burnt 16-candle gas, and gave the proper maximum amount of light with gas of this quality. When the Standard Committee recommended that the gas, instead of being limited to 5 cubic feet per hour, should be regulated so as to give a light of 16 candles, they were really going as far as the Committee of the Institution recommended. With reference to the value of the standard, there certainly were some little variations and discrepancies; but still, as that matter was *sub judice*, he would say nothing further upon it. He quite appreciated what Mr. Hunt had said with reference to the appointment of a small Committee of the Institution; and, if it would strengthen the hands of the London Gas Companies, it would be a very good thing.

Mr. T. S. LACEY (Pimlico) thought the Methven screen not exactly comparable with a 10-candle Dibdin standard. In the case of the screen, the light was emitted from all four sides, which converged with the angular position of the burner. In the case of the Dibdin standard, however, there was no difference in the light, which came from either side or the bottom. The only difference was in the part which was the top of the screen; and partly to obviate any error on this account, the top was made the centre of the disc. He did not think, therefore, that there ought to be any considerable error in placing the 10-candle standard at varying distances from the screen itself. No doubt the standard could not be 10 candles if it was placed very far from it. It was intended, when it was used, that it should be fixed at a certain distance; and it ought to be defined that the bar should be of a definite length. Though the difference might be slight, it was evident that the light thrown on the disc of a 100-inch bar would not be the same as it was on the 60-inch, though the error might be small. With the Methven screen, in which the centre instead of the top of the burner was taken, this error would be considerable; because the extra light would be from each side and the bottom. Mr. Wright had raised

* See Vol. XIX., p. 447.

some very serious points with regard to the variability of the standard. The most important advantage in having a new standard was to get rid of candles, because of their imperfections. It was necessary to make an enormous number of tests to say what a candle was. In substituting this new standard, it was hoped that the burner, whether it was 10 candles or 11 candles, would be the same in every place and under all conditions; because it must be remembered that the photometer was not merely the instrument. It consisted of the photometer and the room, as well as the position of the room, and the conditions of temperature were important. If a photometer were taken from one room to another, one could not predict that the test of the gas would be the same in both places. They had had some disputes with the testers on this account; the differences being from 1 to 1½ candles in the illuminating power. There was not the slightest insinuation of anything unfair on either side. But, as Mr. Livesey had pointed out, photometry was not an exact science. One could not say definitely what the illuminating power of gas was—only that in a certain place, with a particular instrument, it was of a certain character. He defied anybody to take a photometer into a room and say that it would show the same illuminating power for the same gas in various places. They had discovered many things which were very difficult to account for. For instance, they found gas coming along a 14-inch main, when tested at different places, showed very considerable variations; but they found that candles unfortunately did the same. This was a question which required to be cleared up. They had hoped to set it at rest by the substitution of the new 10-candle standard. But it did not; and it was most annoying to find that all the discrepancies attributed to candles had not been removed by the new standard. Before it was definitely adopted, it was necessary, therefore, that the conditions under which it was to be used should be definitely prescribed. He did not think these burners had often been tested one against another—that is to say, a 10-candle standard at each end of the photometer. He had tested such a standard with a constant gas-flame, and had never found them agree. He could quite understand that differences in the temperature or in the ventilation of the room would have a considerable effect; and it was also quite possible that the 10-candle standard might not agree at the two ends of the photometer. He knew that, under certain atmospheric conditions, the 10-candle standard was seriously defective. This used to be the case with candles; but he did not anticipate that the new standard would be equally sensitive. Questions had certainly been raised with regard to its behaviour which required to be threshed out. They could not be slurred over or ignored. Either the Institution or independent engineers would have to deal with the matter in some way.

Mr. WRIGHT, in reply, said if Mr. Methven's criticism, that he had in his experiments departed from instructions laid down for use of the standard, had been well founded, the paper would never have been written; but, as a matter of fact, the tests, in many of the cases described, were strictly according to the conditions attached to the instrument. In certain experiments, however, it was absolutely necessary to deviate from them, in order to explain, if possible, why the standard, as used according to the instructions, exhibited variations. The only way in which to carry on an experiment was to keep changing the conditions, in order to find out in what direction certain influences operated. He need here only refer to Series C. That was a series in which the standard was used precisely in the manner directed; and it showed the most serious variations. It was on the basis of this that the other experiments were conducted. Also with regard to what had been said as to the position of the flame with reference to the terminal of the photometer. This unfortunately did not apply to the experiments. If it had done so, it would have saved him some trouble, and would have caused the experiments to take an entirely different direction. In the case of Series C, the two standards were placed in a certain position where equivalents were produced; and if he reversed the standard, the equivalents should not have been disturbed. But they were disturbed; and he hardly saw how the point to which Mr. Methven had referred, could operate in this case. Like Mr. Hunt, he might say that, when he was first introduced to the new standard, he was very favourably impressed with it, and thought that in future all scientific investigations which called in photometry as an aid, would be rendered easy and accurate. It was with this belief that he commenced to investigate the matter. But the farther he went, the more variations he observed—in certain cases even greater than those already described. In some of the experiments on the new standard, when used precisely as specified by the Committee, and a standard that answered in every manner to the specification, he found serious variations. Some of these were evidently due to the locality in which the standards were used. Mr. Hunt had said, with great justice, that much of what he stated with regard to the double rate lost its force, because with ordinary qualities of gas this double rate, giving the same value, would not often happen. But there were two answers to that. In the first place, if to-day they were making gas from one material, to-morrow they might be making it from another; and by the difference in the material used for enrichment, there might be a difference in its behaviour. Consequently they must not think only of to-day, but of possible eventualities. In a short time, some perfectly new enriching material might be used. He admitted in the paper that in some instances he had found a certain accordance which would have rendered what he said unnecessary. But the Committee, in making their report, had not said that the gas should be tested at 16 candles, which was the ordinary quality referred to by Mr. Hunt; but they specified, in Article 13, that the gas should be burnt from a "London" argand at whatever rate was found requisite in order that it should give a light equal to the prescribed number of candles—not 16, as the prescribed number might be 18 or 14 in the case of some corporations. If it were 18 candles, then more often than not they might be troubled with the question of the gas giving the same candle flame-value at two rates of consumption. This would happen more frequently with 18-candle gas than with 16-candle. He therefore thought it would be much better to say it should be burnt at the lowest rate that would give that candle flame-value. With what Mr. Lacey had said, he entirely sympathized. He could quite understand that a corporation had to keep up the public interest by testing the gas; but in many cases the test was a perfunctory one. In the case of the London Companies, however, whose gas was tested right and left by the Referees, who had the power of prescribing the instrument, and the method of testing, this question was of vital importance. Anything that would alter the standard, as Mr. Methven said he had found, nearly 0·3 candle, was of importance. They all thought the standard should be a certain thing; other people might think it should be something else. But he would not object to any standard if it were invariable; and he believed that even the Gas Companies would hardly object to one, even if it made their gas 0·2 or 0·3 of a candle worse than it really was, if it was always to be the same. If, however, it was going to be one thing one day and another thing on another day and in a different place, and if it was of such a nature that one could never predict what it would be in any place or at any time, it was most seriously defective.

Mr. G. S. SAYNER (Harrogate) has forwarded to us the notes of some remarks he made to the author of the paper at the close of the discussion. He stated that, as an evidence of the importance of the questions brought forward by Mr. Wright, more particularly in reference to the part of the paper dealing with the relations between air and gas supply and points of maximum efficiency in the argand burner, he had observed in his town, where they had a 14-candle standard of supply, that, under certain conditions of atmosphere, the average corrected illuminating power, with the London 24-hole argand burner, was notably higher in candles per cubic foot when the consumption exceeded the 5-feet rate, than when it averaged below that rate. This showed the necessity for having a burner made specially for each of the various qualities of gas stipulated to be supplied, or, seeing that 16-candle power was evidently not the ideal, of having the standard of quality most applicable for universal adoption determined as soon as possible—say, by the Committee suggested—and so fixed by Parliament. This would remedy the discrepancies, and solve for Mr. Livesey and others in like perplexity what he thought at present an enigma. As a proof that (say) 14-candle power might be a better standard for

general supply from the phase of its efficiency, the comment of the public (residents and visitors) in his town was entirely to the effect that the general lighting was superior to those towns which had a higher standard to supply by which they were surrounded. One remark which was particularly prominent—the general absence of blackened ceilings in the case of Harrogate as compared with the neighbouring towns with 18 candles or so for a standard—confirmed the idea that nearer 14 than 16 candles was better with normal air supplies. He thought he was borne out in this by all other places having a similar standard of supply where, as at Harrogate, they had made a feature of developing the efficiency at the burner; and thus, by having more complete combustion, were obtaining the maximum efficiency per unit volume of the gas.

INCANDESCENT GAS LIGHTING.

By Vivian B. Lewes.

Gas lighting by means of the incandescent mantle has made such wonderful progress during the last two years, that the Council of the Institution felt that a paper on the subject, which would bring forth the views of gas managers with regard to it, would at this juncture prove of use.

The term "incandescent gas lighting" so often applied to the Welsbach and other similar systems, might with equal correctness be given to any luminous gas-flame, as they all owe their luminous power to the incandescence of solid particles within them. In the luminous gas-flame, the heat of the combination taking place between the combustible gases supplied to the flame and the oxygen of the air, gives an intense outer zone of combustion which is the hottest part of the flame; and the baking effect of this upon the gases within gives rise to the chemical changes that lead to the separation of solid particles of carbon which, heated to incandescence by various causes, emit light.

In the incandescent mantle, a different method of obtaining radiant light is resorted to. With one exception, which will be mentioned later, the gas is burnt in an atmospheric burner under conditions which would generate from it the greatest intensity of heat, but no light; and this heat is then utilized to raise to incandescence a refractory material in a very fine state of division.

The fact that substances could be raised to incandescence and utilized to emit light, has been known from a very early period; and probably the first application of it is to be found in the Drummond or lime light, in which solid lime is raised to incandescence by the intense heat developed by the oxy-hydrogen or oxy-coal gas-flame. In the more modern developments which have led to the present systems of incandescent lighting, the temperature of the atmospheric burner has been utilized to produce the necessary incandescence, by reducing to the uttermost limits the size of the particles of refractory materials which are to be heated.

The first step in this direction was due to Talbot, who, in an article on "The Nature of Light," published in the "Philosophical Magazine" for 1835 (Vol. III., p. 114), points out that "paper soaked in a solution of chloride of calcium and burnt in the flame of a spirit-lamp, leaves a white network of ashes, which, when held in the feeblest alcohol flame, emits a brilliant light." In this simple experiment we have the clear enunciation of the principle which underlies the present successful methods of forming an incandescent mantle—the idea of saturating cellulose, of which both paper and vegetable fibre consist, with the solution of the salt of a metal. On burning the saturated cellulose, the organic matter is destroyed, considerable shrinkage takes place, the metallic salt is decomposed, and the skeleton of the original fabric is left in refractory metallic oxide, which, on account of the small mass of material, has but little conducting power, and is readily raised to incandescence. Talbot's experiment was considered of sufficient interest and importance to be quoted in Gmelin's "Handbook of Chemistry," which was the leading text-book on the Continent, and which occupied the same position here after its translation and publication in the early fifties.

The next stage in the growth of the system was the inception of the form of the mantle, which is due to Cruickshank, who in 1839 took out a patent (No. 8141 of 1839), in which he claims to obtain light from gases and vapours that do not contain the proportion of carbon necessary to produce a bright flame, by constructing a cage of fine platina wire gauze or network in the form of the flame, and just so much smaller than the flame that it may be entirely immersed in the outer portion of it, where it will become intensely ignited. He also claims platinum alloys as well as platina for the wire the mantles are made of.

Here the shape of the mantle is not only set forth, but the reason for making it in that form is correctly stated, and shows clearly that Cruickshank thoroughly understood how to attain the best results with the material he was employing. Farther on, in the same patent, he continues: "Although the light emitted by platina at a high temperature is very bright, it is inferior to that of lime and other earths at the same temperature." He therefore attempts to combine the advantage of the solid metal network with the high incandescence of the oxides of the earth metals, by coating the platina mantle with a paste of such earths.

Such composite mantles could never succeed in practical use, as the difference in the rate of expansion and contraction between the metal core and the oxide coating must result in the latter flaking off. But the idea was a distinct advance, and clearly foreshadowed the Lewis platinum, and the Sellon platinum alloy, mantles.

Ten years later—1849—Frankenstein made his so-called "Solar" and "Lunar" lamps, which were sold in Paris for a short period, and which were described in "Le Technologiste," Vol. X., 1848-9 (p. 247), and also in Dingler's "Polytechnisches Journal" of the same period. These lamps were either argands consuming oil (solar) or spirit (lunar); while a fabric was introduced into the flame, which by its incandescence emitted light. This fabric was made of a cone or lace net or gauze, coated with a thin paste of magnesia and lime mixed with gum arabic. On placing this mantle in the flame, the fabric burns away, and leaves the skeleton of earthy oxides, which becomes incandescent.

Here we have the combined idea of making a mantle of combustible fabric which can be burnt away so as to leave only the inorganic residue; but the process described differs from the method adopted by Talbot, and afterwards by Welsbach, of impregnating the fabric with a soluble salt which only becomes oxide during the burning off of the organic material, as the oxides are used as a paste, and are coated on to the fabric. This difference at first sight appears trivial; but in reality the possibility of making a mantle which will not fall to pieces on burning off the organic matter depends upon it.

Cotton and other fibres consist of exceedingly minute tubes; and when a mantle composed of such fabric is soaked in a solution of a soluble compound of the metal, such as a nitrate, these minute tubes suck in the liquid by capillary attraction, and when the mantle is then dried, the interior of the tubes is left filled with the salt. When the organic matter is burnt away, the fabric contracts to about half its original size; the salt within the tubes fusing as the heat rises, and then decomposing to a solid core of oxide which has sufficient cohesion to prevent its falling to pieces, unless roughly used. When, however, the fabric is coated with the oxides as a paste, no fusion, and but little contraction, is possible; and as the organic material burns out, it leaves a tube of oxide which, having no cohesion between the particles, drops to pieces as the organic foundation is consumed.

When one attempts to make a Frankenstein mantle according to the directions published at the date of its manufacture, it is found practically impossible to do so. But from the description of the manufacture of similar lamps, it is evident that Frankenstein did not publish the full method, which was to mix common salt with his ingredients, and to use brine instead of water in making the paste. The salt—sodic chloride—by double decomposition, converted some of the earthy oxides into soluble chlorides; and these entering the fibres of the fabric gave the desired result, which could not have been obtained by the use of a paste of insoluble oxides.

From this short review of the history of attempts at incandescent lighting prior to 1850, it is evident that all the principles which underlie and are employed in the manufacture of the mantles at present in use were not only known, but had to a certain extent been utilized, even at this early period.

After 1850, there came a period of inactivity with regard to attempts at obtaining incandescent mantles; and with the exception of a French patent granted to MM. Galafer and Villy in 1862 "for gas-burners surmounted with an indestructible tissue cap," nothing was done of any importance until 1880. It is worth noting, however, that in 1878 Mr. Edison patented the idea of coating a foundation of platinum wire with oxides of such high emissivity for light as those of zirconium and cerium, or any other of a refractory nature, applying them to the wire in the form of nitrate, oxalate, or acetate, which, on heating, would leave a stronger and more cohesive coating than Cruickshank had obtained. This patent is interesting, as it introduces the oxides of the rare metals which now play so important a part in mantle making.

As far as England is concerned, the introduction of incandescent gas lighting may be said to date from the early eighties, as it was then that the Lewis incandescent platinum mantle and the Clamond incandescent light were first introduced and exhibited.

In the Lewis burner, a cylinder, or sometimes a cone, of fine platinum wire gauze was fixed to the end of an open pipe. This pipe was practically a bunsen burner, to which gas was supplied under the ordinary pressure, while air was blown with the gas up an inner pipe under a pressure of 12 to 15 inches of water, and by this rapidity of flow was made to suck in a further supply of external air through some small lateral supply-pipes. In this way, it was possible to obtain a mixture of gas with the theoretical amount of air necessary for its combustion; and a very intense flame was the result. But having to use air under pressure was a great drawback, and prevented the burner from ever having a chance of success; while another serious drawback was that, though it gave a very good light at first, this very rapidly fell away, owing to the surface of the platinum being acted upon slowly by the gas, and coated eventually with carbide, which has an extremely low emissivity of light.

The Clamond mantle, as shown at the Crystal Palace Exhibition, consisted of a conical basket composed of threads of calcined magnesia, which were formed by making a mixture of the hydrate and acetate of magnesium converted into a paste or cream by means of water, and then moulded and ignited, the heat decomposing the acetate, which in its partial fusion during decomposition formed a luting material which glued the particles of magnesic oxide produced into a solid mass, while the hydrate gave off water and became oxide. This basket was supported with its apex downwards in a little platinum wire cage, and a mixture of coal gas and air was driven into it from an inverted burner above it. This form of Clamond burner was fitted with a simple kind of regenerative apparatus. In this case also the air was used under pressure. The chief interest of the Clamond burner was that in the making of the basket the same principle was employed to get solidity in the thread of oxide that has played so important a part in the later form of mantles.

In 1882, Mr. J. S. Williams, of New Jersey, communicated to Messrs. Haseltine, Lake, and Co. an invention for which Mr. Lake took out a provisional specification, dated Jan. 16, 1882. This specification has been rightly described as a farrago of nonsense, and was probably composed with a view of making an incandescent mantle which should have the rigidity of a metal, and the power of emitting light of a refractory oxide. In the occasional gleams of sense which appear in it, there is the undoubted idea apparent of making a mantle of absorbent fabric soaked in a solution of a metallic salt, and burning it off so as to leave an oxide. But having made a mantle which would have been a serious anticipation of Welsbach's patent, he at once proceeded to ruin it by attempting to coat it with a deposit of metal.

On the same day that Williams took out this patent for a mantle to be heated by flame—"thermo-candle," as he calls it—he also took out one for an identical mantle to be raised to incandescence by electricity; and it seems probable that, having in view the earlier attempts of Cruickshank and Edison, he was attempting to overcome the trouble of the oxides flaking off the metal by putting the metal outside the oxides. This patent has been brought forward in all attacks upon the Welsbach patent; but its incoherence and the enormous number of worthless ideas claimed in the forty odd paragraphs of which it consists, and which, as Mr. Moulton once put it, "cover everything from gilded macaroni to blackleaded mince pie," render it an extremely inefficient weapon.

Incandescent lighting by gas had now reached within a measurable distance of success, to attain which in a remarkable degree required but a step—a step, however, which took nearly ten years to complete. The attention of inventors had been called to the light obtainable from incandescence at the Crystal Palace Exhibition; and it was natural that, in attempting to improve upon the result obtained by Lewis and Clamond, the past work on the subject should have been laid under contribution. Talbot's experiment, which gave the idea of impregnating a fabric with a soluble salt, and burning out the organic matter so as to leave a skeleton of oxide, was known to every chemist, from its wide publication in Gmelin's "Chemistry;" the form of mantle to fit the outer zone of greatest heat in the flame had been recognized ever since the time of Cruickshank; while the high emissive power for light of many oxides, including those of the rare earths, had been known as an abstract fact since the days of Berzelius, and had already been utilized by Edison.

The first man fortunate enough to combine the facts ready to hand was Dr. Auer von Welsbach, who, already one of the greatest authorities on the rare metals and their salts, conceived the idea of making a mantle by Talbot's method of impregnation with soluble salts, and burning out the organic material. But instead of using magnesia and lime as the earthy oxides, he utilized the higher emissivity to be obtained by the use of the oxides of zirconium, lanthanum, and yttrium, and protected his combination by the patent No. 15,286 of 1885, which has played so important a part in the recent incandescent trials. Mantles made under this patent were introduced into England in 1886; but they could in no way compare with those now in use—indeed, their unsatisfactory character, combined with administrative difficulties, very nearly wrecked the Company. It was not until Dr. Auer discovered, and in 1893 patented, the manufacture of mantles which should consist of oxide of thorium containing a trace of ceria, that the present phenomenal success was attained. Thorium oxide had been used some time before this, and had been patented by Dr. Auer in 1886; but the factor which led to success was the discovery that minute traces—such as 1 or 2 per cent.—of certain oxides, increased to an enormous extent the emissive power for light of other oxides.

Haitinger had in 1891 suggested using the oxides of aluminium, zirconium, calcium, or magnesium, and then adding 1 per cent. of oxide of chromium or manganese, which was to greatly increase the light-giving power of the mantles; while Dellwik had practically done the same thing a year earlier by making a mantle of such material as alumina, and then spraying salts of chromium over its surface. In utilizing this interesting suggestion, Dr. Auer employed thorium oxide, which gave a fairly strong and lasting mantle, and practically doubled its power of emitting light by adding about 2 per cent. of the oxide of cerium or uranium.

Having traced the history of incandescent lighting to the present date, it will be well to review our knowledge as to the various factors upon which it is dependent.

Incandescence.

When matter in the solid state is heated, it emits light at a lower temperature than either liquids or gases; the amount of light so emitted being dependent partly upon the temperature and partly on the character of the solid heated. With most ordinary solids, the power of emitting light seems to differ but little—*i.e.*, they mostly emit light of the same intensity and character when heated to the same temperature. The following table, giving roughly the character of the light for different degrees of heat, is the one most usually quoted, although the higher temperatures are open to doubt:—

Just glowing in the dark	525° C.
Dark red	700 ,,
Cherry red	908 ,,
Bright cherry red	1000 ,,
Orange	1150 ,,
White	1300 ,,
Dazzling white	1500 ,,

It has been observed from the earliest times that, when the salts of zinc, magnesium, and aluminium are heated on charcoal in the blowpipe flame, they glow with a white incandescence far more luminous than the red heat of the charcoal supports; while the wonderful light emitted by

the combustion of magnesium wire in air, or zinc in oxygen, is far greater than could be accounted for by the heat of the combustion that gives rise to it.

If mantles of the same size be made from the various oxides which it is possible to employ for the purpose, and are heated to incandescence in the same burner under precisely similar conditions, the candle power which they emit will be found to vary from less than 1 to about 6 candles per cubic foot of gas consumed; while with combinations of the oxides, it is possible to get up to 17 candles per cubic foot. This may be due either to the material of the mantle undergoing certain molecular changes which give it the power of producing light, or to the superior radiating power for light which one material possesses over another.

In some recently published researches by C. St. John (Wiedemann's "Annalen," Vol. LVI., pp. 433-50), the author examines this question, and decides that the mantle material has no power of itself to create light, and that the effect is due to temperature alone, and must therefore be brought about by the different power of radiation possessed by the various materials. He finds that, when heated to the same temperature under the same conditions, the ratio between the amount of light emitted by the various substances is as follows :—

Platinum	1·00
Magnesia	3·81
Zirconia	4·04
Erbia	3·33
Lanthana	2·27

That is to say, for the same amount of heat, zirconia converts four times as much into light as platinum does.

These experiments were made by taking a strip of platinum and coating half of it with the oxide to be tested. This was then put inside a small high-temperature furnace, and heated until both the platinum and oxide were at the temperature of the furnace. On looking at it through a small hole in the side, the whole thing is of the same brightness as the background and the walls of the furnace chamber. The light then emitted consists of two parts—some radiated and some reflected. The platinum is the worse reflector, though the best mirror; while the oxide acts as the best radiator. When thermal equilibrium is established, these differences balance one another, so that all appears equally bright. By cutting off the mirror effect, the radiation alone is obtained; and this is done by passing a cool tube through the peep-hole close up to the hot partly-coated platinum. It will then be seen that the platinum appears very dark in comparison with the oxide upon it. The presence of the tube will, of course, exert a chilling influence. But the effect will be greater upon the oxide than upon the platinum—the oxide being the better radiator; and so the results will give the radiative power of the oxide somewhat too low.

From the result of St. John's experiments, one would expect that a mantle made of magnesia would give more light than one of lanthana, while zirconia would be brighter than either. This, however, is undoubtedly not so; a mantle of lanthana being considerably superior to one of zirconia in its power of emitting light.

It is manifest that there must be something more than the differences in the power of radiating light; otherwise, how could traces of certain metallic oxides influence the light-emitting power of other substances in the marvellous way they do? A mantle of thoria alone yields about 6 candles per cubic foot of gas consumed; while if the thoria is carefully purified, the result is still lower. But the addition of 1 per cent. of ceria causes it to emit 12 candles. A mantle of yttria gives about 3 candles per cubic foot of gas. But add 1 per cent. of ceria, and you obtain 10 candles for the same consumption of gas; and if the proportion of ceria be largely increased, its beneficial results disappear. If this phenomenon were due merely to the radiating power for light possessed by the material, it is manifest that an increase in the proportion of the ceria over and above that which has made such an enormous increase in the illuminating power ought to still further bring up the light-emitting power, instead of largely diminishing and finally almost destroying it.

Still more surprising is the result of adding small quantities of oxide of chromium to mantles made of certain materials which give but little or no light. For instance, a mantle made with alumina yields an amount of light which can hardly be measured; but by spraying certain salts of chromium over the surface of the mantle, and again igniting, as much as 15 candles per cubic foot of gas consumed can be obtained from it.

It is perfectly well known that heat brings about certain molecular changes of a very complex and but little understood character; and in many cases this change is apparently due to the conversion of an amorphous into a crystalline state. In the manufacture of glass, if the pot metal be kept for several days at a red heat which will just soften it, it is converted into a vitrified body resembling china, and which is called Remaur's porcelain. This change in appearance, which is not accompanied by any change in weight, is undoubtedly due to a crystalline arrangement of the molecules of the glass; and many examples of this kind of change taking place during heating could be cited. Berzelius, in the early years of the century, first noticed that certain amorphous bodies appear to be brought into a crystalline state when heated to a temperature below that of their melting-point; and that in undergoing this change they exhibit a vivid incandescence commencing at the point most strongly heated, and extending through the entire mass. After this change has taken place, they are found to possess greater specific gravity, greater hardness, and less solubility.

Nearly all the bodies which exhibit this phenomenon are originally crystalline; but when heated to a certain temperature, they become amorphous, and lose all crystalline form in consequence of water or some other volatile constituent being driven off. When this action has ceased, and no further loss of weight takes place, if they are then further heated they again slowly become crystalline and exhibit this power of incandescence. Among the bodies in which this characteristic was most marked were the hydrates of zirconia, titanic acid, tantalic acid, oxide of molybdenum, oxide of chromium, oxide of rhodium, and some hydrated antimoniates of the metals; while Berzelius especially noticed this phenomenon in euxenite and gadolinite—both of them amorphous minerals, from which the rare earths at present employed in mantle making are obtained. This change of state takes place very slowly, and requires many hours' heating in order to complete it. During the period in which it is going on, the high incandescence of the body continues gradually growing less as the action becomes more and more nearly completed; and it seems probable that not only is the high incandescence of the rare earths used in the Welsbach mantle due to this cause, but also that the diminution in light during the life of the mantle is also to some extent dependent upon it.

It has been stated that the falling off in the light emissivity which is characteristic of all mantles used for incandescent lighting, is due to the wearing away of the material by the friction of the burning gas and air; and that this diminution of surface, taking place as it does with each individual filament of the mantle structure, so reduces the light-emitting surface that a decreased candle power results.

When one considers, however, the enormous increase in the incandescence which is obtained by reducing the substance of a filament when heated in a flame, and remembers that a thick platinum wire is only heated to redness, whereas a very thin one is raised to intense incandescence, and even fusion, in a bunsen flame, it seems more than probable that some such specific action as that just indicated is responsible not only for the high emissive power of the light, but also in some part for the diminution in illuminating power during the life of the mantle; whilst in towns the deposition and carbonization of dust from the air upon the mantle fabric plays an important part in the life of the mantle.

The Influence of the Burner.

With one exception, the bunsen burner, in one of its many forms, is employed for the combustion of the gas which is to raise the mantle to incandescence; and the absolute essential in such a burner is that the combustion of the carbon from the hydrocarbons shall be complete, as, if the air supply is in any way interfered with, a deposition of carbon upon the filaments of the mantle is always liable to take place, and speedily terminates its existence. In all the ordinary burners used with a mantle, the air supply is so arranged as to give a rather larger proportion of air in the combustible mixture than is done with the ordinary bunsen.

A bunsen burning under normal conditions gives the

ordinary violet-blue flame; but if the air supply be then increased, the flame becomes fiercer, and acquires a green inner zone. A slight further increase then causes the flame to flash down the tube of the burner to the nozzle below, from which the gas is issuing. It is easy to show that, with the gas and air burning with the green inner zone, a considerably higher temperature is produced than with the bunsen burning under its normal conditions; and in the burners employed for incandescent lighting, the tube of the burner is generally closed by wire gauze or a perforated metal plate, which prevents the flashing-back of the flame, and allows of sufficient air being mixed with the gas before combustion to give the green zone of combustion.

Under these conditions, there is in reality a double flame—the first being the green cone, which is formed by the coal gas undergoing incomplete combustion at the expense of the air mixed with it; while the outer zone is due to the combustion of the products of incomplete combustion—hydrogen and carbon monoxide—which are generated in the inner flame, and are burning at the expense of the oxygen of the air surrounding the flame. This dual structure is made clear by the beautiful experiment of separating the two cones, which was devised by Mr. Lewis T. Wright, and utilized by Professor Smithells, for analyzing the gases which escape from the inner flame and produce the outer.

If a perfect mixture of the two gases which are to enter into combination be taken, the rapidity of the combustion is increased thereby, and the intensity of the flame is enhanced; and that this is so has been recognized with the oxy-hydrogen blowpipe for a considerable time. The light given by a jet of oxygen and hydrogen impinging upon lime is considerably greater where the gases supplied have been previously mixed in the right proportions, than when using the flame from the form of blowpipe in which the hydrogen burns at the mouth of the jet, and a stream of oxygen is injected by a second tube through the centre of the flame—an arrangement which is known as the "blow-through" jet. This fact has within the last two or three years been applied to the bunsen burner; and M. Denayrouze has made a burner in which a small electric motor working a fan causes a complete admixture of gas and air before combustion takes place. With a burner of this character, I have obtained as much as 27 candles per cubic foot of gas, using a Welsbach mantle and London coal gas—an enormous increase over the ordinary duty obtained from such mantles; while a further advantage is that with this form of burner no chimney glass is used.

Another burner utilizing the same principle is the Bandsept, in which the gas is introduced at a number of small injectors, and fractionally draws in succeeding proportions of air; and with the pressure of gas found in many Continental cities, such a burner gives considerably higher results than could be obtained with the ordinary bunsen. But even this falls short of the results obtained with the Denayrouze burner; while with the gas pressure regulated as in England, the advantage gained is not very great.

The one exception to be found to the method of consuming the gas mixed with air is seen in one form of the De Mare incandescent burner used in Paris. If coal gas be consumed at a union-jet burner, the smaller the burner the less will be the illuminating value obtained for each cubic foot of gas used; and this fact is the more accentuated the higher the pressure of the gas. This result is due to the thinness of the flame allowing the air to more freely permeate, and so to more and more nearly approach complete combustion; while the higher the pressure, the more air will be drawn into the flame at the point where the two jets coalesce. The result of this is that, even with the pressure existing in London, it is easy to make a form of burner which shall give no light, but merely a slight yellow haze from the portion of the flame which is usually luminous; while with the 14-candle Paris gas, supplied at a pressure of 5 inches, an absolutely non-luminous flame of considerable heating power can be produced, and is utilized in the De Mare system for heating a fringe of filaments, of the same character as those composing the incandescent mantles, to the point at which they emit a very considerable amount of light.

It is manifest that, for incandescent lighting, a gas which burns with a non-luminous flame is as good as a luminous gas, supposing the same heat-units can be obtained; and in a number of tests I have lately made with incandescent mantles used with non-luminous water gas, I have been astonished to find that it was easy to obtain an illuminating value of 19 candles per cubic foot of gas consumed. This enormously high duty shows that the dreams of the early exploiters of water gas would have been very near fulfilment, had the present incandescent mantle been at their disposal at the period when they were trying to introduce incandescent lighting by means of the Fahnehjelm comb, which only gives an average of 4·3 candles per cubic foot of water gas consumed.*

In considering the question of getting increased light from the mantle by increasing the energy of the burner, it must be borne in mind that any increase of light procured in this way is obtained at the expense of the life of the mantle, as far as the light-emission goes, and that, though such a burner as the Denayrouze causes a great augmentation in the light emitted per cubic foot of gas consumed, it also limits the period during which the mantle can be employed; and it would not be very far removed from fact to take the light-duty to be obtained from a mantle of given composition as a constant, so that an increase in duty in one direction is accompanied by a diminution in the other. This also seems to point very clearly to the light-emissivity being to a considerable extent due to some at present but little understood molecular change in the material, though the wear of a mantle must of necessity be greater the nearer the fusion-point of the material of which it is composed is approached.

The Influence of the Mantle.

The materials introduced from time to time for the manufacture of incandescent mantles may be divided into two classes: (1) Metals or alloys. (2) Metallic oxides or mixtures of oxides.

The first class have so far not proved commercially successful, as though mantles of platinum and platinum-iridium alloy could be made to yield from 4 to 6 candle power per cubic foot of gas consumed, the formation of carbide on their surface, and the deposition of minute traces of iron upon them from the decomposition of carbonoxyl compounds in the gas rapidly lowered their power of emitting light.

In the second class, two important subdivisions may be made—the first consisting of refractory oxides which have been mechanically moulded into fibres, threads, or rods, as in the case of the Clamond and Fahnehjelm incandescents; and, secondly, the class to which the Welsbach and Sunlight mantles belong, and which is the only class that has secured success. These two latter forms of mantle are the only ones which at the present moment have a legal existence in this country, as though several others have been introduced or proposed, they have either been declared by the Courts to be infringements of the Welsbach patents, or else actions are pending against them; and until these have been decided, it would be waste of time to discuss their chances of success.

The Welsbach and Sunlight mantles are both made of refractory oxides formed by the action of heat from decomposable salts. The oxides are moulded into tenacious filaments by the compression exercised by organic fibres contracting during combustion, and so squeezing into a coherent form the semi-fused and decomposing salts from which the oxides are being produced; the organic matter of the fibre which formed the mould of the mantle being entirely burnt away by the combustion which converted the salts used into oxides.

The carefully-cleaned cotton fabric of which the mantle mould is made is about twice the size of the finished mantle; and this is soaked in a solution of the salt (generally a nitrate) which is to yield the desired oxide or mixture of oxides. Each cotton fibre is a small tube, which by capillary action sucks in the solution; and even after carefully squeezing out all excess of the liquid, these tubes remain practically full. The mantle is then shaped on a mould; and on driving off the moisture by heat, the salt remains as a solid in the interior of the cotton fibres. The dried mantle is then burnt off—the puckered-in portion which forms the top being first ignited, and then the heat

* The Fahnehjelm comb was not mentioned in the historical portions of the paper, as it is only used with hydrogen or water gas. It was introduced in 1883, and consists of a comb of fine rods of refractory oxides set in a metal back, which is fixed at the required height above a flat-flame burner.—V.B.L. [The appliance was described in the "JOURNAL," Vol. XLV., p. 1209; Vol. XLVIII., p. 22.—ED. J.G.L.]

applied from below. As the organic material burns, it shrinks with considerable rapidity, and presses together the salt in which the decompositions that lead to the formation of the oxide are proceeding.

These changes consist of the escape of oxides of nitrogen and the liberation of some free oxygen, which helps the burning off of the organic material. During this decomposition, the original nitrates and the nitrites first formed by the heat fuse, and are pressed together; and the decomposition proceeding, the final residue of oxide remains coherent.

The Welsbach and Sunlight mantles are splendid illustrations of the relative values of the rare and the ordinary oxides as incandescent material—the former relying entirely upon the rare earthy oxides, while the latter contains only oxides of aluminium and chromium.

The choice of oxides for the production of incandescent mantles must be governed by two considerations—first, the power which the oxide possesses of resisting heat and atmospheric influences, and remaining infusible and unchanged; and, secondly, its power for emitting light when heated, and yet giving a strong filament. There are certain oxides, of which calcic oxide, or lime, may be taken as an example, which so rapidly absorb moisture and carbon dioxide from the air, that it would be impossible to use them for mantle making, as they would crumble to pieces within a few hours of being allowed to cool down. Other oxides again, though resisting the action of the atmosphere, emit little or no light; while some give so fragile a filament as to be useless.

The first mantles made by the Welsbach system contained—

Zirconia	60 parts	or	Zirconia . . . 50 parts.
Lanthana. . . .	20 „		Lanthana . . . 50 „
Yttria	20 „		

But these mantles only developed from 4 to 7 candles per cubic foot of gas consumed, and were so fragile that their life was extremely short. The brittle nature of the early mantles was due partly to the properties of the ingredients, but partly also to the mantles having been exposed to the fumes of ammonia after impregnation with the nitrates of the metals. This process—generally known as "ammoniation"—was raised as an important point in the late incandescent trials,* as it undoubtedly renders the mantles more fragile; but the real reason for employing it appears to have been overlooked.

When the 1885 patent was taken out, it was intended that the mantles should be sent out unburnt, as the present method of burning off and then stiffening by means of collodion had not been devised. The solution with which they were impregnated being strongly acid, the fabric would have rotted and fallen to pieces before it got into the consumers' hands, had not all the acidity been neutralized by the use of ammonia gas, which, combining with the nitric acid, formed ammonic nitrate, and converted the nitrates of the metals into oxides and hydrates, and these not fusing during decomposition by heat, spoilt the coherence of the mass.

Many experiments were made to improve upon the light-giving power of the mantles and also their strength; but of the rare oxides which could be utilized, those already employed gave, when used alone, the highest illuminating duty. If mantles are made of the separate oxides, and are then raised to incandescence under the same conditions, the following results per cubic foot of gas consumed are obtained:—

	Candles.
Ceria	1·2
Zirconia	1·5
Yttria	5·2
Lanthana	6·0
Thoria (commercial)	6·0
„ (purified)	1·0

It is evident, therefore, that in the original mantles it was the yttria and lanthana which gave the light-yielding properties, while the zirconia furnished such coherence as the mantle possessed.

Further experiments, made with the view of strengthening the fabric, soon showed that thoria and mixtures of thoria and magnesia gave a stronger and more flexible hood; while the fact was recognized that the light emitted could be to a certain extent varied in colour by the use of particular oxides—ceria giving a yellow, erbia a greenish, and didymia an orange tint.

* See *ante*, pp. 571, 635, 703, 757, 872.

Then came the discovery of the wonderful effect which small quantities of "exciting" oxides had upon the power of emitting light possessed by the mantle, and of the fact that a hood of pure thoria, which only gave 1 or 2 candles per cubic foot of gas consumed, developed 12 candles when mixed with 1 per cent. of cerium, and 16 candles when the cerium was increased to 2 per cent.; this result, however, being about the maximum obtainable. Moreover, the thoria, when used in this way as the basis of the mantle, gave increased strength and life to it; while the illuminating value diminished far more slowly than had been the case with any of the mixtures used before.

As a rule, the candle power undergoes a slight increase at first, remains fairly constant for a considerable period, and then slowly diminishes, until at the end of 1000 hours it has lost about 35 per cent. of its power of emitting light; the diminution being due, as has been pointed out, to several causes acting together. No other combination at present known will give anything like this period of emissivity. Thoria, therefore, is the mainstay of the Welsbach system; but it shares with the other rare earths the drawback of being decidedly costly.

Thorium exists in small traces in many rare minerals; thorite and monazite sand being the chief ones at present used for its extraction. These minerals are worked up by the Vienna Company, who supply the solution of the nitrates of thorium and cerium to the other companies. Dr. G. P. Drossbach states that the mixed nitrates cost the subsidiary Companies from £22 10s. to £25 per kilo. (2·2 lbs.); and that this quantity will make from 900 to 1000 mantles. This means that the rare earths alone cost about 6d. a mantle; while the other materials, labour, and distribution probably bring the cost of a mantle up to about 10d.

It has been suggested that, the thoria being so rare, its price will increase to a prohibitive figure, owing to the demand that has arisen for it. But this is by no means likely, as it is not so much the rarity of the element as the enormous quantity of crude material which has to be handled to yield a few pounds that makes the price so high. It is present in traces in an enormous number of minerals; and the wideness of its distribution may be judged from the fact that Dr. Phipson has lately discovered its presence, together with other rare earths, in the kerbstones used in Putney! [See *ante*, p. 920.]

In all the more successful of the rare-earth mantles, we find the presence of an oxide with decidedly acidulous tendencies, such as thoria or zirconia, mixed with highly basic oxides, such as ceria or yttria; and it seems probable that the great power of converting heat into light possessed by these substances may be due to some such molecular change taking place as the slow conversion of the amorphous oxides into a crystalline compound of the two.

On now turning to the Sunlight mantle as the representative of what can be done with oxides of the ordinary metals, we find exactly similar conditions. The basis of the mantle is alumina, which gives a far stronger filament than the thoria; while instead of using ceria as the exciting material, oxide of chromium is employed. Alumina is well known as having the power to form aluminates at high temperatures with other oxides; and there is no doubt that in the Sunlight mantle an aluminate of chromium is slowly produced.

In the earlier forms of this mantle, mixtures of zirconia and alumina were used as the basis, and were sprayed over with a chromium salt. But these gave a yellow light, and a duty of only 10 candles per cubic foot of gas; and it was found that, by employing a pure alumina basis, sprayed with chromium, a far stronger mantle and a greater emissive power could be obtained—the candle power rising to as much as 15 per cubic foot of gas consumed, and being a white instead of a yellow light.

The relative strengths of the Welsbach and Sunlight mantles were tested by placing the burnt mantles upon their side and putting a strip of writing-paper across the shoulder of the mantle, each end of the strip being supported upon a wooden block of the same height as the mantle itself. Weights were now gently placed upon the paper, so as to press it down upon the mantle; and the Welsbach mantle broke to pieces under a crushing strain of 3 grammes (46 grains), while the Sunlight mantle, although bent nearly flat, only began to show signs of fracture under a load of 13 grammes (200·5 grains). This

difference in the strengths of the two mantles is undoubtedly an enormous advantage in favour of the Sunlight, as it is sufficient to enable the mantle to withstand the action of vibration, which in a busy thoroughfare or a railway station has proved so fatal to the life of the Welsbach mantles as to render their use in such positions almost impossible.

So far every point seems in favour of the plebeian Sunlight. The chemicals used in its manufacture cost but a small fraction of a penny, instead of 6d., and are unlimited in quantity. The strength of the mantle is so great that only accident or violent shock breaks it, and when cold it can be handled with ordinary care; while the light emitted is but a little below that given by the Welsbach. The only remaining question is as to the light-emitting life of the mantle; and I regret to say that, owing to the shortness of time that they have been in my possession, I am unable to speak personally as to this point. From theoretical considerations, I should expect the light to diminish more rapidly than with the thoria mantles. But the strength of the alumina mantle preventing any very great loss of surface from the skin-friction of the burning gas, the illuminating power can be revived by blowing off any clinging dust, and re-spraying with a chromium salt by means of a lady's spray-bottle.

Illuminating Value and Effect of Incandescent Mantles.

It seems at first sight almost hopeless to reconcile the statements made by various observers as to the light emitted by mantles; but these wide discrepancies depend to a great extent upon the conditions essential for obtaining proper results having been neglected.

In order that a mantle shall fulfil its object properly, it must fit that portion of the flame which is generating the highest temperature; and unless the mantle is uniform in shape, and the gas supply is so regulated as to bring the proper portion of the flame in contact with the mantle, the true illuminating value cannot be developed. The result of this is that, if the gas supply is too small, the mantle is not properly immersed in the flame, and only partial incandescence results; while if the flame is of sufficient size, turning on more gas only increases the consumption, without any adequate increase in illuminating value. Even when the gas supply is carefully regulated to the size of the mantle, it is not by any means uncommon to find the light emitted by different sides of the mantle varying by as much as 8 per cent. Another point which has been to a great extent overlooked, is that the illuminating value of the mantle varies with that of the coal gas with which it is used.

In all gases made by the retorting of coal, the volume of hydrogen and carbon monoxide undergoes but slight alteration, while the illuminating value depends upon the hydrocarbons present; and the higher the proportion of these, the greater will be the heating power developed by the combustion of the gas, and the higher the duty of the mantle. With London coal gas, the mean of a large number of experiments with the present Welsbach mantles gave 16 candles per cubic foot of gas as their illuminating value.

Mantles have been tested which gave 19 candles; while others have only yielded 11. But 16 may be taken as a fair average. Experiments show that, starting with 16 candles as the light emitted by the mantle per cubic foot of 16-candle gas, the duty of the mantle rises or falls by approximately 0·6 of a candle for each candle rise or fall in the illuminating value of the gas between the limits of 12 and 25 candle gas—*i.e.*, the 14-candle Paris gas will give $16 - (0{\cdot}6 \times 2) = 14{\cdot}8$ candles per cubic foot; a Scotch 25-candle gas will yield $16 \times (0{\cdot}6 \times 9) = 21{\cdot}4$ candles.

No calculation of this character can be absolutely correct; but the results obtained are sufficiently near to give a useful idea of the illuminating value to be expected from a Welsbach mantle with coal gas of any given quality. During the past few years, much has been said as to the wide difference which exists between illuminating value and illuminating effect; and one of the factors which have given rise to the divergence of opinion existing on this point is our absurd method of determining the photometric value of the horizontal rays emitted from any source of light, and looking upon the results so obtained as representing the lighting value.

No one would dream of sitting with the source of light level with the table on which he is writing; and the result is that, though the values recorded by the photometer for various burners give a ratio of value for the band of light on the walls in the same horizontal plane as the burner, they tell us absolutely nothing as to the relative value of the light cast by those burners upon our book or work, which is probably at an angle of 45° below the horizontal. That great differences do exist in the value of the light-rays emitted from various kinds of burners when measured at varying angles, was pointed out by Mr. Dibdin some years ago; and he then devised a radial photometer by which rays at an angle to the horizontal could be measured. Little attention, however, has been paid to this point; and the horizontal illuminating value is tacitly accepted as giving the value of the burner.

The illuminating effect of the incandescent mantle is an excellent illustration of the error into which this confusion of ideas leads us. Ordinary observation shows that, in a shop illuminated by incandescent mantles in clear glass chimneys without reflectors, the burners being fitted to the ordinary brackets, &c., the upper shelves and ceiling are brilliantly illuminated, while the counter and floor appear badly lighted in comparison. This is due to the mantle emitting its maxima rays of light on the horizontal plane, and for a few degrees above it, while for angles below there is a rapid falling off in direct rays; and though this is, to a certain extent, corrected by the reflected rays from the ceiling and upper part of the walls, there is still a serious deficit at the lower angles.

For all practical purposes, it is the amount of light emitted at an angle of 45° which is the important factor in domestic lighting; while for street lighting, all angles from the horizontal downwards are utilized. In the following table, I have recorded the light emitted by a Welsbach mantle at various angles from 45° above to 45° below the horizontal—the values being carefully determined on a radial photometer. In order to see the influence of reflection from walls and ceiling, the first set was taken in a room blackened throughout; while the second set was taken in one of the same size with white ceiling and light-coloured walls:—

Angle.	Candle Power per Cubic Foot. With Blackened Ceiling and Walls.	With White Ceiling and Light Walls.
45°	8·75	11·23
40	9·72	11·80
35	11·28	13·26
30	12·25	14·90
25	13·22	15·01
20	13·60	15·30
15	14·58	15·53
10	14·97	15·71
5	14·97	16·13
Horizontal	14·97	16·34
5	14·58	16·34
10	13·60	15·93
15	12·43	14·30
20	11·28	13·26
25	10·69	12·60
30	9·72	11·23
35	7·78	10·21
40	6·22	9·19
45	5·05	8·60

In performing the experiments in the room under normal conditions—*i.e.*, with white ceiling and light-coloured walls—care was taken to prevent light escaping from the standard used, by enclosing that end of the photometer in curtains. From these results, it is evident that, when using the unshaded mantle in an ordinary chimney, the light obtained at the working angle is only one-half that with which the mantle is credited, while if the ceiling be dirty and the paper dark, the duty of the mantle may fall to one-third its theoretic value.

In order to overcome this serious diminution of light at angles below the horizontal, and also to soften the glare and colour of the light emitted, many forms of globe and chimney have been proposed and introduced; but in most cases a better distribution of the light has been accompanied by considerable loss of illuminating value. The whole tendency of our modern improvements in illumination has been to obtain great intensity from a comparatively small illuminating surface. This is neither good for the eyesight nor for the illuminating effect; a large illuminating surface of low intensity being far better from every point of view.

The globes designed by Psaroudaki and Blondel, and lately introduced under the name of "Holophane" globes, give us the power not only of correcting the irregular distribution of light from the mantle, and bringing the maxima of rays down to the working angles, but also make the surface of the globe the light-distributing media. In order to do

this, the globe is made of clear glass, so moulded that the exterior consists of horizontal lines of prismatic form running round the globe, while the interior is covered by vertical lines of prisms running from the top to the bottom. If the globe had only the horizontal prisms around it, the source of light in the centre of the globe would appear as a vertical band of light, as is seen in the Frédureau globe; and if the vertical prisms only were present, the light would be drawn into a horizontal band in the same plane as the mantle. But the combination of the two draws the light evenly over the whole surface of the globe. The horizontal prisms are so moulded as to deflect downwards the excess of light otherwise escaping upwards, and so give an increase in illuminating power over the working angles; while the large surface of emission makes the light pleasant instead of irritating to the eye.

Conclusion.

In this paper, the author has done his best to deal impartially with the subject of incandescent gas lighting, which is certainly one of the most important topics to the gas world that could be found. In treating it, he has thought it better to bring out the facts which are probably least well known; leaving the results of practical experience to be developed in the discussion, which it is to be hoped will be worthy of the importance of the subject.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1123.)

THE general tone in the Stock Markets has undergone very little change during the week just closed. The public, taken in the mass, are playing a waiting game in those markets where, until recently, they operated freely and fearlessly; for the past seven days have not contributed much towards the solution of outstanding difficulties. But still in other very speculative fields—cycles and such like—their bump of caution is not sufficient to hold them back. The gilt-edged division have done well; for hoards of money must go somewhere at last, however long the holders may put off buying, and Consols may be quoted strong at 112½. The issue of a 2½ per cent. debenture stock by the Great Western Railway is a historical landmark. Thanks in no slight degree to the settlement, the Money Market has had a brighter week; and better rates were obtained than have been seen for a long while. Business in the Gas Market was rather sluggish at first; but it quickened up later on, and became fairly active. The tendency was excellent; and a large number of issues have risen considerably in value. In point of fact, prices in general are susceptible of improvement; and many issues which have not moved in the market are quiescent simply because there is nothing doing in them, and they only await the chance of actual business to show what they are worth. In Gaslights, the "A" opened unchanged, and hung fire for two or three days; being marked once on Wednesday at 305. Then it took a rapid turn, and advanced daily in price; and on Saturday it was done at 311. At the same time, the demand for choice investments pushed up the secured issues materially; and several made considerable improvement in value. South Metropolitans were very quiet; and the only change was a rise in the buying price of "C." A little business was done in Commercial old, which put the quotation up a point. The Suburban and Provincial undertakings were full of strength; and anything offering readily commanded an advance. Brighton, Brentford, and British were quoted higher. The Continental Companies were not particularly active, and showed no particular feature. Among the rest, the most noticeable was Cape Town, which advanced another point and a half, with business done at 17¼. If the forthcoming accounts justify such a figure, the Company must have been doing pretty well. Water was quiet, but very strong. Several quotations rose; and Chelsea, paying its full rate of dividend, has advanced to a less than 3 per cent. for money figure.

The daily operations were: Business in Gas was very languid on the opening day; and variations were slight. Brentford debentures rose 1; and Cape Town, ¼. Transactions remained restricted on Tuesday; but prices showed more in advance. Gaslight "J" improved 5; ditto "C," "D," and "E," 2; and Brentford debentures 1. In Water, Kent new rose 3. Wednesday was another quiet day; and the only move was a rise of 2½ in South Metropolitan "C." Activity began to awake on Thursday; and Gaslight "A" started its advance with a rise of 2. Friday was buoyant; and the upward movement was in full swing. Gaslight "A" rose 1; ditto "K," 4½; Brighton original, 5; ditto "A," 3; and Cape Town, 1. In Water, Chelsea gained 5; New River, 1; and ditto debenture, 1. The progress was well maintained on Saturday. Commercial old rose 1; Gaslight "A," 2; and ditto "H," 1. In Water, Chelsea advanced 2; and West Middlesex, 5.

NOTES.

A Systematic Error in Photometry.

In a short paper on "The Action of Light on the Iris, Demonstrated by a New Pupilometer," published in "Nature" for the 16th ult., Professor Charles Henry describes the instrument, which proves experimentally there is almost always a dilatation of the pupil when the iris is withdrawn from the light. In any case, the variations of dimensions of the iris are much less when it is the iris alone which is subjected to light, than when the iris and the retina are influenced together. If, by means of the Houdin pupilometer, we observe the pupil of one eye while the iris of the other is obscured, we remark on the said pupil a dilatation of from one-half to one-quarter millimetre in the diameter. Among other experiments, Professor Henry tried to find with his pupilometer the relation existing between the pupillary contraction and the illumination of the retina. This discovery of the direct action of light upon the iris, leads to a number of curious conclusions. Among others, it shows that our photometric measurements must involve a slight but systematic error. When the eye is directed towards the more luminous of two lights, the iris contracts; tending thus to equalize the lights for the retina. It is, perhaps, in this movement of the iris that we should seek an explanation of the discrepancies that are constantly being met with between the data of our photometric processes and those contributed by observation of sensitive plants. It is well known, for instance, Professor Henry says, that a branch of *Vitia sativa* placed between two lights equal for our eyes and equidistant from each other, invariably tends to incline towards one of them.

Non-Conducting Coatings for Steam-Pipes.

A novel appliance for testing the virtue of non-conducting coatings for steam-pipes has been devised by Mr. Charles L. Norton, of the Massachusetts Institute of Technology. In this arrangement, the troublesome and messy water-condensing process usually followed, is replaced by a device for maintaining a pipe containing oil at any desired temperature, by means of an electric current. The outer surface of the pipe can be covered by the non-conducting substance to be tested; and then the number of watts of current expended in maintaining the interior temperature exactly constant, divided by 1055, gives the number of British thermal units lost per second in doing so. Tests are preferably made at a temperature corresponding to a steam pressure of 200 lbs. absolute. With the loss of heat from the bare pipe as a standard to start from, it was made to appear that an arrangement of air cells as non-conductors reduced the loss to something between one-quarter and one-third; and this arrangement was nearly as efficacious as any non-conducting device tried. It would appear, from these and other experiments of a like character, that the fundamental requirement in non-conducting coverings for preventing loss of heat is that they shall contain as much air-space as possible, and prevent the movement of air in the vicinity of the surfaces to be protected.

Sea Water for Road Watering.

A letter of Mr. F. J. Barnes, dated from the Isle of Portland, upon the subject of the use of sea water for watering roads lately appeared in the "Builder;" and it is interesting in connection with the proposal to introduce the same variety of the fluid into London, to which reference has already been made in the "JOURNAL." The writer states that in his island sea water was used for many years for watering roads, with "most ill effects." Where the roads were surfaced with the hard limestone affected for the purpose in this locality, the result of wetting them with sea water was to leave the whole substance of the macadam saturated with salt, which with the slightest moisture from fogs or other causes very considerably aggravated the muddy and slushy condition of the roads. This was also a very serious fault during a thaw after frost, when the whole road was disintegrated down to as far as the salt seemed to have penetrated. Where the roads were faced with Guernsey granite, with a view to bearing the heaviest traffic, the application of sea water caused them, if at all hilly, to become unusually slippery. Besides, no matter of what the roads are made, the soaking of sea water into them must have a prejudicial effect upon trees planted beside them. The net result of several years' experience in this matter in the Isle of Portland is that sea water, though procurable for nothing, has been abandoned for road-watering purposes; and fresh water, which is scarce and dear in the isle, is used in its stead.

The Molecular Annealing of Iron Castings.

Some curious observations on the hypothetical mobility of molecules of cast iron, have been laid before the American Institute of Mining Engineers by Mr. A. G. Outerbridge. The author refers to the generally accepted belief that cast iron, under repeated shocks, becomes brittle, and will ultimately break under a blow which it would otherwise have withstood. It will probably surprise metallurgists and engineers, therefore, to learn that experiment disproves the supposed fact, and goes far to establish the exact opposite. Mr. Outerbridge declares that the result of about a thousand tests of bars of cast iron of all grades, enables him to assert with confidence that, within limits, cast iron is materially strengthened by being subjected to repeated shocks or blows. It is well known that the usual process of

annealing castings increases their strength by relieving strains due to unequal cooling; but it is not so well known that, in consequence of the fact of the molecules of cast iron, as of all other solids, being capable of movement, they can in certain circumstances rearrange themselves. The author draws attention to the fact that, if a casting—such as a wheel—breaks in service, it usually does so early in its life. If it does not crack when comparatively new, it will probably last until worn out. A crucial test was made by subjecting six new cast-iron test-bars to 3000 taps each with a hand-hammer upon one end only of the bar. All the bars so treated exhibited a gain of strength of from 10 to 15 per cent. One practical conclusion from these experiments is that castings which are to be subjected to severe strains in actual use, should never be suddenly tested to anything approaching the severity of their intended service. Quantitative tests made upon the impact machine, show that the molecules of cast iron rearrange themselves under reasonably few shocks; so that it is perfectly practicable to molecularly anneal such castings when cold. Pulleys, and, indeed, all castings, are subjected in every-day use to this process of molecular annealing; and old castings are therefore more reliable than new ones, unless they have been misused.

The Present Dry Season.—According to the report presented to the Official Water Examiner for the Metropolis (Major-Gen. A. de Courcy Scott, R.E.), the quantity of rain which fell during past week was much below the average of the last thirty years. It was actually 0·58 inch; the average over the period named being 1·66 inches. The total deficiency in the first four months of this year was 3·06 inches.

Midland Association of Gas Managers.—The spring meeting of this Association will take place to-morrow week at Banbury. We learn from the programme issued by Mr. C. Meikeljohn, of Rugby, the Hon. Secretary (which, we may remark parenthetically, contains some interesting historical particulars of the old town and neighbourhood), that it is proposed to have a saloon carriage attached to the 10.20 a.m. train from Snow Hill Station, Birmingham, which will reach Banbury at 11.36. On arriving, the members will be conducted by the President (Mr. W. R. Cooper) to several places of interest on the way to the White Lion Hotel, where the formal business will be disposed of. Luncheon will be provided by the Chairman and Directors of the Gas Company, in conjunction with the President. At its conclusion, brakes will be in readiness for a circular drive *viâ* Broughton Castle (where tea will be served at the Round House); and Banbury will be reached in time to catch the 6 p.m. train for Leamington and Birmingham. This will bring to a close what we trust may, in the words of the final line of the programme, prove to be a "happy day."

European Petroleum Company, Limited.—Our readers will see by an announcement which appears to-day in another part of the "JOURNAL" that a Company has been promoted, under the above title, with a share capital of £1,000,000 in 500,000 cumulative preference shares, and a like number of ordinary shares, all of £1, of which 333,340 of each class are offered for subscription. Applications will also be received for £400,000 of 4½ per cent. first mortgage debentures of £100 each, repayable on May 1, 1911, at 5 per cent. premium. They will be secured by a trust-deed, charging the whole of the assets. The Company (which is presumably the undertaking referred to in the paragraph which appeared in the "JOURNAL" on the 5th inst.) has been formed to develop the trade in the subsidiary products of crude petroleum, to the supply of which, as well as of kerosene, their operations will be directed. The vendors, who are the promoters, have fixed the purchase price at £1,120,000, payable at the option of the Directors, as to £166,660 in ordinary shares, a similar amount in preference shares, £133,330 in debentures, and the balance in cash. The Chairman of the Company is the Marquis of Granby; the Vice-Chairman being the Earl of Winchilsea and Nottingham.

The Manchester Institution Excursion Meeting.—Favoured by brilliant weather, the Manchester District Institution of Gas Engineers had a most enjoyable excursion last Saturday. The programme arranged for this, the one-hundred-and-sixth quarterly, meeting of the members provided for an early start from Manchester and Huddersfield, so as to reach Worksop by 11.30 a.m. At noon, luncheon was served at the Lion Hotel; and subsequently some formal business was transacted, under the presidency of Mr. Isaac Carr, Assoc.M.Inst.C.E., of Widnes. This merely consisted of the confirmation of the minutes of the previous meeting—read by the Hon. Secretary, Mr. S. S. Mellor, of Northwich—and the election of four new members. These were: Mr. Thomas Brown, of Matlock Bridge, Mr. William Lister, of Matlock Bath, Mr. William Prince, of Stoke-upon-Trent, and Mr. James Woodward, of Kirkham. Brakes then left the hotel conveying the party (numbering some 70 in all) to Welbeck Abbey, the seat of the Duke of Portland, where a visit was paid to the world-renowned underground roads and rooms and the picture gallery. Thence the drive was continued, through the "Dukeries" to Edwinstowe and back through Thoresby Park and Clumber Park, the seats of Earl Manvers and the Duke of Newcastle. After tea at the hotel, the party broke up in time to reach Manchester and Huddersfield by the train leaving Worksop at 7.12.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Mr. Lewis T. Wright's Gas Institution Paper.

SIR,—I have read with great interest Mr. Lewis T. Wright's paper on "The Efficiency of the London Argand at Different Rates of Consumption;" but I should like to have more light thrown upon what he means by "the true 16-candle gas might be . . . 15·6 under the Instructions of the London Gas Referees, or even less." Most people look upon illuminating power tests made in strict accordance with the Referees' Instructions to be criterion tests. Now, accepting for the present that such tests are right, and that by no other method can we get more than 15·6 candles out of any particular sample of coal gas, how can such gas be called anything else but *true* 15·6-*candle gas*, considering that the rate of consumption was 5 cubic feet and the temperature and pressure normal? I am quite aware that, if these conditions were altered, other results would be obtainable. But the point is, by what other method can we speak of the result as being *true* or even *truer* than by the Referees' method? This I consider to be of vital importance.

In another part (4) of the paper, dealing more in particular with the Dibdin standard, I was struck by many of the results quoted; and I shall be obliged if Mr. Wright will describe a little more fully his method of operating in (say) Series A and B—giving, if he can, the times allowed to burners to get hot before comparing them. I presume one air-holder was used; but at what pressure was the air delivered to the carburettors to be finally regulated at the burner-cock?

East Ham, May 15, 1896. W. GRAFTON.

The Birmingham Corporation and the Gas Supply of the Outlying Districts.

SIR,—In your issue of the 12th inst., you write of a policy that has lost the city of Birmingham the gas supply of all the outlying districts. This is a mistake.

The Bill for the transfer of the Staffordshire gas undertaking to the Corporation was opposed by several of the local authorities outside the city. Under the Act authorizing the transfer, four of the outlying districts separated themselves from the undertaking. The local authorities outside the extended city boundaries yet remain within the area of supply. Three of them have, in later years, promoted Bills for the purchase of the supply within their respective districts. In each case these proposals have been defeated by the vote of the ratepayers in those districts. In the discussion, which led to this result, both the policy of the Corporation in relation to its gas supply, and the result of the transfer of the supply in the four districts referred to, received ample attention.

Birmingham, May 15, 1896. EDWIN SMITH.

The Accident to a Gasholder at Gothenburg.

SIR,—Allow me to thank Mr. Samzelius for his kindness in answering my queries. I have carefully thought over his answers; and, in relation thereto, I should like to state the following propositions: I find as a fact—(1) That a high degree of *elasticity in the structure* of a holder (126 feet in diameter, double-lift) will put that holder 6 inches out of its level in a quarter of its periphery. (2) That such a holder, *if not properly balanced*, will, in its usual working, show a difference of 12 inches at diametrically opposite points, even though all the wheels are on the face of the guides. (3) That such a holder, if on one side of it the cup contains (say) 18 inches depth of water, the other and opposite side may contain only 7 inches—that is, a difference of 11 inches of water.

My opinion is that the tilting and destruction of the Gothenburg holder arose from want of rigidity, and want of balance, aided by a want of depth of cup and the light perilously near. These causes concurrent in their action were under the favourable conditions of (*a*) the cup of the holder being too wide, and thus preventing the easy recovery of position from oscillation; (*b*) the rollers on the standard running in the channel-irons being fixed on the outer lift, and thus potentially at certain points making a fulcrum; (*c*) the system of rollers implying opposing forces, and thereby giving too much play of the rollers.

I admit that the Gothenburg holder shows a certain boldness of design; and the only fault I have to find with the designer is that he did not more thoroughly carry out what De Morgan calls the "calculus of inference," and Boole the "calculus of differential equations."

It is most surprising that the action of gasholders has never been considered in any of the proceedings of gas men for the past thirty years, as I have a continued record for that time. If gas men would take the trouble to pay a little more attention to their floating balloons, they might perhaps more practically realize the abstract proposition of forces in equilibrium, and forces in motion.

In conclusion, I think the old way of having the outer lift with top and bottom rollers, *plus* having rollers in the centre of the outer lift, would give more security to the anxious watcher than many devices requiring extensive verification.

Calcutta, April 22, 1896. D. COATS NIVEN.

Sir,—With reference to Mr. Cripps's letter in the "JOURNAL" for the 5th inst. (p. 980), I may inform him that the plan for adjusting my holder was settled in February; and the point of protecting life and property was not less considered then than before.

I agree with Mr. Cripps on points 1 and 2—that the cup *did* "blow," and at a depth of water *less* than the gas pressure. But I cannot agree with his conditions 3 or 4—thatt he holder *must* have tilted or jammed in the guides.

In my "Conclusion" (*ante*, p. 810), I have shown that at the time of the accident the holder was satisfactorily guided, because it was at its full height. This was not contested by Mr. Cripps, who admitted that

it was strange that the holder was upset when it was fully inflated. I hinted that the cup might perhaps have been emptied by other means. But Mr. Cripps now only declares that the holder *must* have tilted; and, if not, that it *must* have jammed in the guides (in level position, the gauges remaining invariable!). So it is asserted, shortly, since Mr. Cripps has condemned the guiding because of the enormous play!

Using Mr. Niven's expression, we have received in Sweden from Mr. Cripps a lesson as to the *conditions* for tilting that were not unknown to us before; but the *causes* of the accident still remain unrevealed. With sincerest thanks to Mr. Cripps for the kind interest he has shown in the matter, I hope this correspondence will now end.

I must correct my statement (*ante*, p. 810) in this respect, that steam *was* applied to the cup at the fire; but the valve was very little opened. A man in the fire brigade was burnt at the steam-pipe during the fire.

Gothenburg, May 12, 1896. HJ. SAMZELIUS.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Bills last week :—

Bills read the first time, and referred to the Examiners: Bournemouth Gas and Water Bill, Kirkcaldy and Dysart Water Bill.

Bills read a second time and committed: Brighton Corporation Water Bill, Huddersfield Water Bill, Lancashire (Middle Ward District) Water Bill, Matlock Bath Gas Bill, South Metropolitan Gas Bill.

Bills reported, with amendments: Colwyn Bay and District Gas Bill, Drogheda Corporation Bill, Newcastle-upon-Tyne and Gateshead Gas Bill.

Bill read the third time and passed: Ilfracombe Gas Bill.

HOUSE OF COMMONS.

The following progress was made with Bills last week :—

Bills reported: Bexhill Water and Gas Bill, Chelsea Water Bill, Edinburgh Extension Bill, Lambeth Water Bill.

Bill reported, with amendments: British Gaslight Company (Norwich) Bill.

Bills read the third time and passed: Bournemouth Gas and Water Bill, Kirkcaldy and Drysart Water Bill, Rotherham Corporation Bill.

HOUSE OF COMMONS COMMITTEE ON THE LONDON WATER BILLS.

Tuesday, May 12.

(*Before Sir* J. PEASE, *Chairman; Sir* J. BRUNNER, *Mr.* BALDWIN, *Mr.* BOND, *Mr.* J. STUART, *Mr.* BRIGG, *Mr.* FRY, *Mr.* LEES KNOWLES, and *Mr.* MUNTZ.)

The Hybrid Committee appointed to consider the various Bills dealing with the water supply of the Metropolis—viz., the Chelsea, Lambeth, New River Company, Southwark and Vauxhall, and Staines Reservoirs Bills—held their first public sitting to-day, and proceeded with the

CHELSEA WATER BILL.

Mr. PEMBER, Q.C., and Mr. RICKARDS appeared for the promoters. The petitioners against the Bill were the Conservators of the Thames, the Corporation of London, and the London County Council. The Corporation were represented by Mr. LITTLER, Q.C., and Mr. RIGG; the County Council, by Mr. BALFOUR BROWNE, Q.C., Mr. WORSLEY TAYLOR, Q.C., Mr. FREEMAN, Q.C., and Mr. KEMP; and the Conservators reserved their Counsel.

Mr. RICKARDS, in opening the case, said the Bill was a very simple measure, and a very short one; and it would require extremely little explanation. Of course, the Company had had regard to the Instruction to the Committee as to the additional amount of capital that had to be raised, and also as to the urgency of the works which were proposed under the Bill. Shortly described, these works were the duplication of the existing main between West Molesey and the filter-beds of the Company at Ditton, power to construct which was asked for only in the interests of the consumers, and in order to provide against failure of supply owing to any accident that might occur to the existing main of the Chelsea Company between those points. The works of the Company consisted of subsiding reservoirs and intakes; and a communication 36-inch main from West Molesey to Ditton. The proposed duplicate pipes would not follow the line of the existing main. They would both be of the same size—namely, 36 inches; but while the old main carried water by gravitation, with the new one it would be necessary to resort to pumping to some extent. In round figures, the existing main would carry a maximum of 14 million gallons per day of 24 hours. This maximum had been already reached; and, therefore, it would be seen that they were brought face to face with the fact that they could only just carry enough water along the existing main when their supply was at its highest. Of course, in the summer a larger quantity of water was used than in the winter; and the maximum then reached was, on the average, about 12½ million gallons. It was proposed in future to convey the water by using the existing main of the Company as a gravitation main, for which purpose it was capable of conveying 9½ million gallons, and to make a pumping main to carry, on an average, with comparatively little forcing power on the pumps, another 9 million gallons. When, therefore, these works were completed, they would always be able to supply by gravitation and moderate pumping 18 million gallons of water per day; while at the present time they were supplying a maximum of 14 million gallons. The new main was designed so that the upper service of the pipes would be in no part less than 36 inches below the surface of the ground. The Company had thought it right, in the interests of the public, and with a view to the experience gained by some of the Companies in the great frost of 1894-5, to lay their main at this depth. The only other work proposed was an additional acre of filter-bed—that was to say, an actual acre of surface, which, again, would obviously be in the interests of the water consumers. Really the case for these works seemed to him such an obvious one, that he hardly felt called upon to make any remarks to recommend them to the Committee. They were what were known as "unremunerative works." Of course, when a water company extended their main, enabling them to give additional services, they put themselves in a position to earn more profits. But when a company came to Parliament, as in the present case, and asked merely to construct works which would enable them to improve their supply both as to quantity and quality, no remarks seemed necessary to support it. For the purposes of this Bill, they proposed to raise a sum of £50,000 of debenture stock. This was dealt with in clause 12; the first part of which was as follows: "The Company may from time to time raise, by the creation and issue of debenture stock, any sum or sums not exceeding in the whole £50,000, and may create and issue debenture stock accordingly; and the provisions of Part III. of the Companies' Clauses Act, 1863, as amended by the Companies Clauses Act, 1869, shall, so far as applicable, apply to the debenture stock so to be created and issued. But notwithstanding anything contained in the said Acts, the interest of all debenture stock at any time after the passing of this Act created and issued by the Company, shall rank *pari passu* with the interest of all mortgages at any time after the passing of this Act granted by the Company, and shall have priority over all principal moneys secured by such mortgages." The district the Company supplied was inside London, and consisted of the parishes of Chelsea and Westminster. The Company were incorporated in 1721. But by the Chelsea Water-Works Act of 1852, previous Acts were repealed; and inasmuch as there had been a report by a Special Commission recommending—or rather demanding—that no water should be abstracted from the Thames below Teddington Weir, the Company took powers and lands for the purpose of supplying water from Ditton. In 1875, the main intake was transferred by the Chelsea Water Act of that year to West Molesey. This was really the position of the Company now in regard to their water supply. The *status quo* of the Company with reference to its district and the amount of water allowed to be drawn from the Thames, and in regard to all matters except the additional works authorized by the Bill, was left entirely untouched by the measure. There was no new principle whatever involved in it. At present the share capital of the Company was £1,058,640; and the debenture capital, £175,785. They had a small margin of unused debenture capital—about £34,000—part of which was unissued and part not called up; and this was only sufficient to meet the annual extension of the mains authorized by previous Acts. The construction of the new filter-bed and the laying down of the proposed main would cost £48,000; and there would thus only be £2000 left as a margin to be applied to the acquisition of land, the expenses of the Bill, &c. The second paragraph of clause 12 was as follows: "The Company shall attach to the debenture stock to be created under this Act interest at such uniform rate as, in the opinion of the Governor for the time being of the Bank of England, or of some person to be nominated by him, shall be best calculated to secure the issue of such stock at par, to be payable half yearly at the same time and in the same manner as the interest on the existing debenture stock of the Company. The Company shall not raise the money by this Act authorized to be raised by creating new shares of the Company, instead of borrowing, or convert into share capital the debenture stock authorized to be raised under the powers of this Act. Provided that, fourteen days before applying for such opinion as above mentioned, notice in writing of any application for that purpose shall be given to the Clerks of the London County Council and the Surrey County Council, and to the Town Clerk of the City of London." By these provisions, the Company would get such a rate of interest as would ensure the issue of stock at par. The Bill contained clauses providing that the debenture stock should be redeemable at par after a certain period, and that new debenture stock should be offered by auction or tender. There were also clauses as to notice of sale; as to stock not sold by auction or tender being offered to shareholders; and also as to the application of premium arising on the issue of stock. Clause 19 summed up the whole of the clauses as to the amount asked for. It read as follows: "It shall not be lawful for the Company to create and issue any greater nominal amount of stock under the powers of this Act than will be sufficient to produce, including any premiums which may be obtained on the sale thereof, the total amount of £50,000; but in the event of such stock being issued at less than par value and resulting in a deficiency in the nominal amount of the additional capital hereby authorized to be raised, the Company may issue such additional amount of debenture stock as shall make good the deficiency so resulting." The Committee would notice that the Bill did not provide for the creation of a sinking fund; the capital asked for being so small as to render this unnecessary.

The CHAIRMAN: Is there no sinking fund in any of your Acts?

Mr. RICKARDS: No.

Mr. FREEMAN: They have not been to Parliament since the sinking fund has been introduced—they have not been since 1866.

Mr. RICKARDS pointed out that the Billl had originally been petitioned against by several bodies. The Conservators of the River Thames were not appearing by Counsel; and the promoters had satisfied the objections of the Corporation of Croydon, the Lambeth Vestry, and the Surbiton Urban District Council.

Mr. FREEMAN said that, in order to save the time of the Committee, he might state that this was a Bill suspended from last session; and they were, no doubt, aware that a great many things had happened since then. All the petitioners asked for in the present Bill was the introduction of a sinking fund clause such as had been introduced into all measures of late years; and, furthermore, they objected to the promoters having power to take water from Seething Wells, which there was good reason to believe was very impure and unfit for dietetic purposes.

Mr. RICKARDS remarked that this point could not be raised then, as it did not form part of the petition.

Mr. *R. Hack*, the Engineer to the Company, gave evidence as to the necessity for an extension of the works. He said that the proposed main would not carry as much water as the old one, for the reason that it would not have the same fall. They only proposed to provide for what would be required in the immediate future. The increase in consumption had been very rapid, owing to the building of high houses, which were let in flats. He insisted on the necessity of preserving Ditton as the source of intake.

An argument arose on the cross-examination by Mr. FREEMAN, as to the right of the London County Council to object to water being taken at Thames Ditton; but the Committee decided that, on amending their plaints, the petitioners might be heard on this point.

In cross-examination, witness said that the Rivers Mole and Rythe entered the Thames at Ditton, and rendered it unfit for drinking purposes. The water from these rivers at certain periods was turbid, and mixed with sewage effluent.

Mr. *G. H. Gill*, the Secretary to the Company, then gave evidence as to the financial position of the undertaking.

In cross-examination by Mr. RIGG, witness suggested that the amount of capital sought for was so small that it did not seem to the Company to be necessary to insert the sinking fund clause.

Mr. RIGG: So you think that you of all the Water Companies should escape this clause?

Witness: I do not say that.

Do you not recollect that in 1886 the East London, the Lambeth, and the Southwark and Vauxhall Water Companies came to Parliament with Money Bills?—Yes.

And that this was the first time the sinking fund clause was applied to their capital?—Yes.

Do you know that in 1888 the clause was voluntarily inserted in their Bill by the Kent Company?—Yes.

In 1891 did not the Southwark and Vauxhall Company come with a Bill for more capital; the Bill when deposited including a sinking fund clause?—Yes.

In 1891 the sinking fund clause was altered a little, was it not?—Yes; and in 1894 the East London, the Southwark and Vauxhall, and the West Middlesex Companies were all in Parliament for money, and the settled sinking fund clause was put into their measures.

Then beyond the question of the smallness of the capital you are asking for, have you any other objection to the sinking fund clause? Well, I may venture to say that, in respect to any other reason, the Directors would not make a fight of any length over the point.

Professor *Crookes*, F.R.S., who was the next witness, gave evidence as to the excellent quality of the water supplied from Ditton, as well as from Molesey.

Professor *Dewar*, F.R.S., a member of the Royal Commission on the London Water Supply, declared that under chemical analysis the difference between the filtered water that came from the Thames at Ditton and that which came from higher up the river was unappreciable. The water which came down from the Mole, after being impounded and filtered, was of excellent quality. He regarded the supply of the Chelsea Company as an admirable one. Of course, there were microbes in the Ditton water, even after filtration. There were 40 different kinds of microbes in the human mouth; and the human body was full of them. In fact, there would be no digestion, no organic change, no supporting life, without them. A piece of butter as large as a finger-nail contained five million micro-organisms; and milk teemed with them.

By Mr. J. STUART: He did not agree with the Local Government Board that it would be a good thing to prevent the Chelsea Company from using the water from Seething Wells. Still, he thought they should not take more of that water, in proportion, than they were doing now.

Mr. STUART: If they did increase the quantity, would it be deleterious to the consumers?

Witness: No; but it would be a mistake. The water gets cloudy at times; and the deposit from it would clog up their filters, retard their operations, and cause them increased expense. Continuing, witness said that he had read the report of the Local Government Board; but he denied that there was any bacteriological difference to be found in the water supply of the Company when the quantity taken in from the Mole was increased.

This concluded the case for the promoters.

Mr. FREEMAN then briefly addressed the Committee for the London County Council; confining his remarks to the two points to which he had referred earlier in the proceedings. He was dealing first with the question of the sinking fund clause when

The CHAIRMAN (interrupting) said the Committee had already arrived at a decision on the point. They thought that the amount asked for, though small, should be treated like the big ones. The request of the petitioners would be conceded.

Mr. FREEMAN then dealt with the question of the water taken from Seething Wells. He said that if the Committee were of opinion that the question of the use of this should be left open, he would agree to the insertion of a proviso to the effect that the water should be used only in cases of emergency.

Mr. *A. R. Binnie*, M.Inst.C.E., the Engineer to the County Council, was the first witness called on behalf of the petitioners. He declared that the water which was taken in at Ditton came partly from the Mole, and was heavily contaminated with sewage. No doubt water of this kind might be drunk with impunity for years; but in the end it might take on itself morbid qualities—no scientist could tell why—and the result might then be disastrous. He himself, in years gone by, had suffered from cholera spread by the water taken from this very place; but there had been no cholera through this supply since the intake had been removed above Teddington Weir. The London cholera outbreak of 1866 could, no doubt, be traced to the water supply.

Mr. *Taylor* gave corroborative evidence as to the polluted state of the Thames water at Ditton.

Wednesday, May 13.

On the resumption of the proceedings this morning, no further evidence was offered by the Corporation of London or the London County Council; and the Committee thereupon called upon Mr. Pember to submit a statement setting forth the amount of water taken by the Chelsea Company at Seething Wells, which was condemned by the petitioners as unfit for drinking, and also the amount of water taken at Molesey.

Mr. PEMBER accordingly handed in a statement, in which it was shown that a large quantity of water was still taken from Ditton. The amount so abstracted had in 1895 reached the figure of 42,000,000 gallons in a fortnight, or 3,400,000 gallons per day; and the total secured at both intakes amounted to 14,000,000 gallons a day.

The Committee at this point consulted in private. On the public being re-admitted,

The CHAIRMAN said it was the opinion of the Committee that, after the new main from West Molesey was completed, the water from Seething Wells should not be used in the ordinary way, but only to meet cases of emergency or accident; and that whenever this water was so used, the fact should be notified to the London County Council. The Committee were willing to hear Mr. Pember for the Company, if he thought he could advance anything likely to change their views.

Mr. PEMBER, in reply, said that, under similar circumstances, he had declined to make replies; and he should adhere to that course now. But, without seeking to do what the Committee suggested, he would point out that it was a mistake to think that the supply from Seething Wells had ever been given up. The reason it had been treated differently from the Molesey intake was because it was found that the water was turbid, on account of the clay banks of the River Mole. It was considered desirable, therefore, for economic reasons, to give up to some extent this source of supply. There was, however, no prohibition against the use of Seething Wells water. It was a fact that at the time the Company were before the Royal Commission they were not using these wells; but then they were only supplying 9 million gallons per day, whereas the consumption had now risen to a much higher figure. No doubt the proposed new main would enable the Company to rely much more than formerly on the Molesey supply; and if, after he had said this, the Committee thought the water taken from Seething Wells should be used only in cases of emergency, he would offer no further objection.

The CHAIRMAN said he did not think that the point put before them would induce them to change their opinion.

Mr. PEMBER replied that, under the circumstances, the only thing he would venture to say was that the Chelsea case differed in many important particulars from the one he was now about to ask the Committee to consider; and he trusted that in connection with this Bill, the Committee would keep an open mind.

The CHAIRMAN then announced that the Committee found the preamble of the Bill proved.

The consideration of clauses was postponed.

Mr. PEMBER said he wished simply to state, in order to clear up the matter, that, as the Committee were aware, there had always been a discussion between the London County Council and the Water Companies as to the quantity of water the latter could take from the Thames. Put in another way, the facts were these: The London County Council disputed the validity of a certain agreement between the Water Companies and the Thames Conservancy Board, under which the Companies could take larger amounts of Thames water than were specified in their Special Acts. It should be understood that, if the emergency provision was introduced in the Bill, the view of the London County Council as to the validity of the Company taking the quantity of water specified in the agreement with the Conservancy Board should not have effect.

The CHAIRMAN: There is a limit to the amount of water to be taken—a limit of 22 million gallons.

Mr. STUART: Do you put forward the theory that you can take 22 million gallons from Molesey, and as much as you like at Seething Wells?

Mr. PEMBER: I do.

Mr. STUART: Yes; but that point does not come before us.

The Committee then proceeded with the Lambeth Water Bill, the consideration of which occupied them till the close of the sitting on Thursday, when they declared the preamble proved. The sinking fund clause is to be retained, and the "emergency" clause put in. Clause 10, giving power to acquire additional lands by agreement, is to be taken out; and the estimate amended by £10,000. On Friday, the clauses of the two Bills were considered and amended; and the Bills ordered to be reported. The Staines Reservoirs Bill was then taken; and Mr. Littler was proceeding with his address when the Committee adjourned till to-day (Tuesday). A fuller report of these matters will be given next week.

The Proposed Amendment of the Metropolitan Counties Water Board Bill.—In addition to the amendments already noticed (*ante*, p. 1042) to be moved by Lord James of Hereford in Committee on the above Bill was the following, to form the final division of the proposed new clause: "(3) A parish in a Metropolitan County, but outside the Metropolitan Water Area, shall, until otherwise provided by Parliament, be exempt from contributing to the expenses incurred by the Council of, such county in promoting, or opposing, or applying for the insertion of provisions in any Bill above mentioned which does not affect such parish." Lord Aldenham gave notice last week of his intention to move that the Common Council of the City of London should be represented on the proposed Board by four instead of only two members; and that the expression "Metropolitan Water Area" shall, unless the context otherwise requires, mean the "Administrative County of London, and every parish outside that county to the whole or any part of which any Metropolitan Water Company is for the time being authorized to supply water." Other amendments were notified last week by Viscount Knutsford, Earl Cowper, and Earl Stanhope.

Gas-Works Extensions at Walsall.—The Walsall Corporation have received the sanction of the Local Government Board to the loan of £48,000 for which they recently asked, and which is required for gas-works extensions. The cost of certain retorts and furnaces (£1160) is, however, to be deducted, as it is considered that these should be paid out of revenue, and not from capital.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Thursday, April 30.

(*Before Mr. Justice* LAWRANCE *and a Common Jury.*)

Dickson v. Blandford Water-Works Company.

This was an action to recover a sum of £163 13s. 1d., the amount of the final certificate given by the Engineer of the Company. The Company, by their defence, alleged that they had already paid a sufficient amount in respect of the work; that the certificate was improperly given; that certain extras were improperly included; and that there were defects in the work for which, by way of counter-claim, they sought to recover £50, and £250 as damages for delay in completion of the works.

Lord COLERIDGE, Mr. SYDENHAM JONES, and Mr. E. G. MEARS appeared for the plaintiff; Mr. JELF, Q.C., and Mr. BULLEN represented the defendants.

Lord COLERIDGE said this was a claim by a contractor against the Water Company, who had employed him to construct their works. In 1893, the defendant Company issued advertisements for tenders; and the plaintiff's tender of £6197 10s. 6d. was accepted. The Company's Engineer was appointed to superintend and control the work while it was in progress. The mode of payment was the usual one—namely, upon the certificate of the Engineer given from time to time as the work went on. The Company reserved to themselves power to keep a certain percentage in hand; it being part of the contract that after the works were completed, the plaintiff should keep them in working order for six months. The works were to be completed, to the satisfaction of the Engineer, by May 1, 1894; and the contract stipulated that the contractor should be liable to a penalty of £3 a day if this time was exceeded. There was also a provision that, in case of additions, the time might be extended. Out of the £500 retained by the Company, the sum of £300 was to be paid to the contractor one month after the date of the Engineer's certificate; and the final balance of £200 at the expiration of the term of maintenance, provided the Engineer certified that the works were in good and substantial order. It appeared that when the tenders were sent in, the Company had not even purchased the ground on which the works were to be placed. The contract was to commence at and from Nov. 1; but owing to this default of the Company, operations could not be begun until the 21st of that month. The works were not completed within the specified time; and in respect of this matter the Company now claimed £228, by way of penalty. In September, 1894, when a payment was made on account of the final certificate, no reference was made by the Company to the fact that the contract had not been completed within the specified time. It was only when the plaintiff pressed for payment, that this complaint was made.

Mr. *Beasley* said he had had 35 years' experience in carrying out water and drainage schemes. He was employed by the defendant Company; and had there been no extras or deductions, his estimate would not have been exceeded. He had given his final certificate, and considered that the plaintiff was entitled to the sum now claimed.

Witness was cross-examined at considerable length with a view of showing that there had been some quarrel between himself and the Company—that the work had been scamped, and the like; but this he strongly denied. He admitted that the pipes had to be flushed to get rid of stones; but this was a usual thing. He also admitted that the engine-room floor, according to the contract, was to consist of an inch of cement over chalk or other material; but the portion now produced consisted of a mere coating, and ought not to have been passed.

In re-examination, witness said that, having regard to the delay in the Company purchasing the land, to the extras, and to the time during which he (witness) had directed suspension of the works during frost and inclement weather, he did not consider any penalties were due.

Mr. *W. R. Wayne* said he had been in the service of Mr. Beasley for six years; and he had superintended the works in question. There were delays owing to frost and bad weather, otherwise due progress was made.

Cross-examined: He had now left Mr. Beasley's employ. He had frequently complained to Mr. Beasley about Mr. Dickson's delay in carrying out the work; but there was really no great delay. The work was not scamped. The flooding to get rid of the stuff which was in the pipes was done before the Company took over the works—some time in July. He had tested the cement used for the engine-house. He had 1-inch blocks made, and broken by machinery; and they stood the test which was specified.

Plaintiff was also called in support of his case, and denied that there had been any scamping.

After further evidence had been given on behalf of the plaintiff,

Mr. JELF opened the case for the defendants. He submitted that the Directors were only doing their duty towards the shareholders in resisting what he described as an unrighteous claim. The contractor had been paid more than he ought to have received. He did not allege that Mr. Beasley was acting in collusion with Mr. Dickson; but he did say that he had played the part of the partizan. He should prove by evidence that the work had been very improperly carried out in many respects, and that owing to the delay the Company had lost a large sum in water-rates. They, therefore, considered they were entitled to enforce the clause as to penalties.

Friday, May 1.

This morning, evidence was called for the defence.

Mr. *W. J. Fletcher*, F.R.I.B.A., M.Inst C.E., said he had been Surveyor to the County of Dorset since 1874. He came into connection with this case owing to the water-pipe crossing three bridges. Mr. Beasley applied for leave to cut a chase in the masonry of the big bridge across the Stour; but it was impossible that this could be allowed. On his suggestion, a method of "threading" was carried out, which was much less costly than the plan originally proposed; and he did not think this should be regarded as an extra. This part of the work had not been done in a workmanlike manner. He had examined the engine-house and cottage, and found that the work had not been carried out according to the specification. The fair cost of putting the engine-house and cottage in a state in accordance with the specification, would be about £50.

Mr. *P. A. Barnes*, wool stapler, carrying on business at Blandford, stated that in consequence of the slow progress made with the work, he had warned both Mr. Dickson and his foreman of the danger they incurred of being hindered by the rising of the springs in January; and he wanted them to avail themselves of favourable weather. Mr. Dickson said they should have finished by May; and he did not then claim that he should have any deductions because he had not been fairly started. No such suggestion was made until this action was about to be commenced. Discussion took place as to the increased work; and Mr. Beasley had told the Board thirty days would be sufficient for that. As to the weather, there were a few days of hard frost; but afterwards the season was particularly open for work. The Company had sustained actual damages to the extent of £25 wages paid to Mr. Wayne. Then there were losses owing to the delay in their being able to make connections, and thus losing customers for a period of two months. They retained £163 as against bad work, additions, deductions, and delay. Mr. Beasley had sent in a certificate which the Board had repudiated.

Cross-examined: The work, as a whole, was entirely unsatisfactory, but he admitted that in the first annual report of the Water Company, of which he (witness) was Chairman, it was stated that the works were, with slight exceptions, most satisfactory. They did not wish to tell the shareholders of all their disputes.

By His LORDSHIP: They gave the shareholders to understand that they should not have to pay any more money to the contractor. The capital of the Company was £6000; and they had also issued debentures. They had power to raise £10,000. There were 117 shareholders.

Further evidence having been given as to the condition of the cottage and pumping-station.

Mr. JELF and Lord COLERIDGE addressed the jury, and

His LORDSHIP summed up. He pointed out a great peculiarity of the contract, in that the certificate of the Engineer was not final—"No certificate or approval of any work by the Engineer shall affect or prejudice the right of the Company against the contractor, or considered or held to be conclusive as to any of the work." The question was whether the defendants were entitled to take anything out of the £163. As to the £50 claimed as requisite to put the cottage and engine-house in proper condition, it would not matter whether it would take £50 or £150, if the jury thought the defendants had offered to relieve the plaintiff thereof for £12, and that offer had been accepted by the plaintiff. As to the condition of the house, if it was as bad as pictured by the learned Counsel and the witnesses for the defence, it was astonishing that the Directors should allow it to be inhabited by their workmen. His Lordship dealt minutely with the various claims for delay; and in conclusion left the following questions to be answered by the jury: (1) What period, if any, should be added for extra work? (2) What time, if any, should be allowed for bad weather? (3) Was the delay before the contract was signed caused by the defendants' inability to hand over the land to plaintiff. If so, what time should be allowed for such delay? (4) What would it cost to make the engine-house and cottage equal to the requirement of the specification? (5) Did the defendants agree with the plaintiff to take the repairs into their own hands for the sum of £12? (6) Did the alteration in taking the pipes over the bridge entail a larger expenditure on the plaintiff? (7) What damage have defendants incurred by the delay of the plaintiff?

The Jury gave the following replies to the questions: (1) 58 days; (2) 21 days; (3) 14 days; (4) £12; (5) Yes; (6) No; (7) Nothing.

His LORDSHIP having meanwhile left,

Mr. JELF said, of course, application would be made to his Lordship on another day for judgment on these findings.

Saturday, May 2.

After a long legal argument as to the way judgment should be entered upon the findings,

His LORDSHIP said that he would take time to consider his judgment.

Later in the day,

Mr. JELF announced that the parties had come to terms; thus relieving his Lordship from the necessity of delivering judgment. It had been arranged that verdict should be entered for the plaintiff for £50, and taxed costs; and, further, that there should be no appeal.

His LORDSHIP stated that in his opinion this was a very wise termination of the litigation. Whichever way he had decided, he could see before him a long vista of litigation.

Tuesday, May 12.

(*Before the* LORD CHIEF JUSTICE *and Mr. Justice* WILLS.)

South Staffordshire Water Company v. Sharman.

This was an appeal by the plaintiffs from the judgment of the County Court Judge sitting at Lichfield, in an action of detinue for the recovery of two gold rings found upon their premises. The defendant was employed with others to clean out the Minster Pool, and while so engaged several articles of interest were discovered; the defendant finding imbedded in the mud at the bottom of the pool two rings, which he refused to deliver up to the plaintiffs. He afterwards placed the rings in the hands of the police authorities, who by means of advertisements tried, but unsuccessfully, to find the original owners; and ultimately the rings were returned to the defendant. The plaintiffs applied to the police for the rings; but they declined to hand them over, on the ground that they had not been entrusted to them. At the trial, it was proved that there was no special contract between the plaintiffs and the defendant as to giving up any article which might be found; and the County Court Judge held that the defendant was entitled to retain the rings. But he allowed an appeal on condition that defendant's costs were paid by the plaintiffs in any event.

Mr. W. WILLS appeared for the plaintiffs; Mr. DISTURNAL represented the defendant.

Their LORDSHIPS reversed the decision of the County Court Judge, and entered judgment for the plaintiffs; holding that they, being the owners of the *locus in quo*, had practical control over it, and of the things contained therein.

(*Before Mr. Justice* DAY.)

Yorkshire and Lancashire Water Gas Company, Limited, v. Faraday.

This was an action in which Mr. Michael Faraday was sued for £35, being 10s. per share on 70 shares held by him in the above-named Company, and interest. The defendant applied for, and had allotted to him, 10 shares in April, 1889; and in the following May he purchased in the market 60 shares, which were duly transferred to him. A call of 10s. per share (there being £2 payable on each share, two months after allotment, according to the prospectus, but it was not required at the time) was made in May, 1893. The defendant had put in a long defence, raising all sorts of questions about misrepresentation. But he did not appear to support it; and he had admitted, in answer to interrogatories, that he had received notice of the allotment and of the call. Mr. T. H. Swan, formerly the Secretary, and now the Liquidator of the Company, having produced the register and minute-book, his Lordship gave judgment for the amount claimed with interest and costs.

COUNTY OF LONDON SESSIONS.—Newington, Thursday, May 14.

(*Before Mr.* SOMES.)

Thefts from Automatic Prepayment Meters.

To-day *John Ingarfield*, 20, a gas-fitter, was indicted for having stolen divers moneys of the Directors of the South Metropolitan Gas Company, and further with having stolen the sum of 1s. 10d., moneys of the Company; and *Robert Lewis*, 27, a carman, was indicted on several counts with having stolen moneys of the Gas Company (see *ante*, p. 988).

Mr. BODKIN, who prosecuted, stated that through some mistake the man Lewis was indicted on the second charge as against Ingarfield; but as he did not wish to offer any evidence against him, he thought a verdict of "Not guilty" against Lewis on that specific charge ought to be returned.

The CHAIRMAN directed the jury to do as suggested by the prosecution; and this having been done,

Mr. BODKIN opened the case against Ingarfield on the second count. He stated that, for the convenience of consumers, automatic gas-meters were supplied; and in these meters were small tills which received money passed into them by consumers, and which was subsequently collected by employees of the Company. It was alleged that on the 13th of April, the prisoner, with another man, proceeded to the house of a Mr. Taylor, at Graylands Road, Peckham; and under the pretence of wanting to examine the gas-fittings, obtained admittance to the house. The prisoners went from room to room, examining the gas-brackets, &c. On coming to the gas-meter, the prisoner asked Mrs. Taylor for a chair, in order that he might examine it; and during the interval when going for the chair, Mrs. Taylor heard sounds, as if one of the two men were hammering at the meter. She returned; and immediately afterwards the men went away. Not feeling satisfied with their conduct, Mrs. Taylor made inquiries; and it was subsequently discovered that the meter had been tampered with, and the money stolen from it. When arrested in Camberwell, the prisoner denied the thefts, but afterwards said he had not done all, but that Lewis had done most of them.

Mrs. *Taylor*, of 35, Graylands Road, Peckham, was called, and gave evidence as to the men—one of whom was Ingarfield—calling at her house on the 13th of April. She bore out Counsel's statement as to the movements of the men inside the house; and she positively swore that Ingarfield was one of the men.

William Hull, a collector in the employ of the Gas Company, proved the reading of the meter a few weeks previous.

Mr. *Manders*, a foreman in the employ of the Gas Company, proved that, from the reading on the 14th of April there ought to have been 1s. 10d. in the till of the meter. The witness also spoke to the condition of the meter. The staple of the padlock was broken; and the till had also been forced.

Detective-Sergeant *Thorley*, stated that on April 22 he arrested Ingarfield. The prisoner asked to be taken to the house in Grayland's Road, which was done; and he was immediately identified by Mrs. Taylor. On the way to the station, the prisoner said he did not commit all the thefts put forward against him, but that Bob Lewis had done some of them.

Detective *Fitzgerald*, who was with the Detective-Sergeant, corroborated his evidence; and the case for the prosecution terminated.

Thomas White, a printers' labourer, was called as a witness for the defence; and he stated that on the day in question Ingarfield and himself were in the City looking for employment.

The prisoner then addressed the jury, stating that he was innocent of the charge, and that on the day in question he was in the City with his witness.

Mr. BODKIN reviewed the evidence in the case.

The CHAIRMAN having summed up,

The Jury returned a verdict of "Guilty;" and the prisoner pleaded guilty to a previous conviction for larceny.

Mr. BODKIN mentioned that the second prisoner, Robert Lewis, had pleaded guilty to the charges against him; and that the other case against Ingarfield would not be gone into.

Warder *Willett* proved several previous convictions against Lewis.

Mr. BODKIN then stated that the Gas Company supplied these meters for the entire convenience of the consumers; and they, having received several complaints relating to exactly similar robberies in South London, communicated with the police. The police were, in fact, making inquiries at the time of the arrest of the two prisoners. In regard to Lewis, he had pleaded guilty to the indictments against him; and there were several other instances in which he was identified as the culprit. It was believed that in the case of Ingarfield it was a solitary charge. A gang of men were thought, however, to be systematically robbing the Company; and what the Company asked was that an example should be made of the prisoners.

The CHAIRMAN remarked that it was a dangerous practice; and a stop ought to be put to it. The sentence of the Court was that Ingarfield be imprisoned for twelve months, and Lewis for eighteen months, with hard labour.

Mr. BODKIN drew the Chairman's attention to the commendation of the police officers engaged in the case by the Grand Jury; and the Chairman endorsed that commendation, as did also the Petty Jury.

Clarke's Registered Design for Electric Lanterns.

Some weeks ago, Mr. Justice North refused, on the application of Messrs. Julius Sax and Co., to expunge the above-named design from the register (see *ante*, p. 344); and an appeal against his decision was argued at considerable length on the 23rd and 24th ult., before Justices Lindley, Lopes, and Kay. Their Lordships delivered judgment on Monday last week. Lord Justice Lindley went in detail through the provisions of the Patents, Designs, and Trade Marks Act and the various cases which had been cited in argument, and came to the conclusion that the design in question was not original or novel, in the sense meant by the Act, and was not entitled to protection. The appeal would therefore be allowed with costs, including the costs in the Court below; and the design would be expunged from the register. Lord Justices Lopes and Kay gave judgment to the same effect.

Charge of Perjury in Connection with the Southwark Bridge Explosion.

At the Lambeth Police Court last Wednesday, James Price, 38, described as a lighterman, of Vine Cottage, Gunnersbury Lane, Acton, was charged with committing wilful and corrupt perjury in his examination upon oath before a Judge sitting at the Lambeth County Court, upon the hearing of a certain complaint preferred by him against the South Metropolitan Gas Company. Mr. Washington prosecuted; Mr. Jonas defended. The case was understood to arise out of an action brought against the Company in connection with the explosion which occurred on Southwark Bridge early last year. Detective-Sergeant Thorley said he arrested the accused on the previous day at his residence. When told the charge, he replied, "Very good. I can explain it. A man named Lander saw me coming over the bridge just after the accident. Also a man named Crusty Walsh, who was throwing snow into the river. He was working for the Vestry. I also met Shannon at the foot of Southwark Bridge. He said, 'Jimmy, I saw that accident. Why don't you go to the hospital? You look bad.' I said, 'I am not hurt,' and when I got home I went to Dr. Thornton's, Uxbridge Road." The prisoner went on to detail a conversation which he alleged he had with Shannon on the preceding Friday with reference to the present proceedings. In answer to Mr. Jonas, Thorley said the accused told him that Shannon advised him to keep out of the way, but that he refused, as he had nothing to fear. Mr. Hopkins remanded the prisoner for a week, but agreed to accept bail in £20 for his appearance.

Gas-Works Profits at Burton-on-Trent.—It was reported at the meeting of the Burton-on-Trent Town Council last Wednesday that the result of the year's manufacture of gas and the sale of residuals was a profit of £10,548, representing 7¼ per cent. on the capital outlay, against £16,081 in the previous year, or a decrease of £5533.

Water Supply in the Isle of Wight.—There is likely to be trouble, says a Southampton contemporary, between the Shanklin Council and the Isle of Wight Water Company. The latter, by an Act dated 1861, obtained power to collect water from springs and streams running into and adjacent to the River Yar; and the Council have taken steps for the purchase of a field at Wroxall containing a water spring which runs into this river. It is said that the yield is nearly 100,000 gallons per day; and the Council have applied to the Local Government Board for authority to borrow £5070 for the purpose of purchasing the field and bringing the water to Shanklin. Only recently the Company served upon the Council a notice to the effect that this water belongs to them, and that the Council will not be permitted to take it. The Council, on the other hand, are advised that they will have, when they have acquired the field, as much right to the water as the Company. If some settlement is not arrived at shortly, it will probably entail a law suit.

Improvements at the Bradford Corporation Gas-Works.—At the meeting of the Bradford Town Council yesterday week, Mr. W. C. Dixon submitted the minutes of the Gas Committee, which included resolutions approving a plan showing a proposed re-arrangement of gas and tar pipes, and condensing and scrubbing plant at Thornton Road gas-works; instructing the Engineer to carry out the improvements at an estimated cost of £1400; and accepting a tender of Messrs. Clapham Bros., Limited, of Keighley, to provide and fix one of their patent condensers for the sum of £715. Referring to the proposed alterations, Mr. Dixon said that some years ago an explosion occurred at the Valley Road works, which was caused by the accumulation of gas owing to the pipes being laid underground. Since then the pipes had been taken up and put overhead; so that, if there was any escape of gas, it would not have the opportunity of accumulating. This system was found to be both more economical and convenient. The same improvement was now being effected at the Thornton Road station. Many old pipes laid thirty or forty years ago had become corroded; and they were to be replaced by pipes overhead. It was also proposed to put in a new condenser, the cost of which was included in the £1400 mentioned in the resolution. The minutes were adopted.

MISCELLANEOUS NEWS.

BIRMINGHAM CORPORATION GAS SUPPLY.

Water-Gas Plant—The Recovery of Cyanogen—Annual Accounts.

The Gas Committee of the Birmingham City Council have issued a report for presentation at the meeting of the Corporation to-day; and it is accompanied by the accounts for the year ending March 31 last.

The report states that for some time past the Committee have had under consideration the question of the further provision of manufacturing plant, which it was known would become necessary at an early date. This question has become one of greater difficulty since the last expenditure on the extension of such plant was undertaken. Owing to the great increase of railway rates at the time of the passing of the Railway and Canal Traffic Act, affecting in different degrees the four manufacturing works, the Committee were anxious not to come to any conclusion on the subject until they were in a better position to judge of the result of various appeals which were, and are, pending against a portion of such increased rates. It seems to be probable that the consideration of future extensions of manufacturing plant for coal gas will be still more largely affected in the future than in the past by the cost of the conveyance of coal to the different works; and for this reason alone, the Committee have been anxious to defer, until such questions are definitely settled, the selection of the site on which such extensions shall be made. For this and other reasons, they, on the suggestion of the Engineers, authorized them, early last year, to make inquiries as to the results obtained in various large gas undertakings in the country by the working of carburetted water-gas plant as an adjunct to ordinary coal-gas plant. By the kindness of the Liverpool Gas Company and the Corporation of Blackburn, the Engineers and Chemists of the department were permitted to attend from time to time at these places, and make careful observations, analyses, and investigation of the working of such plant in connection with the gas supplies of the towns; and a report was made by them on the result of the inquiries. Subsequently the Committee made further inquiries in these and other towns where the process had been adopted, with a view of ascertaining whether any difficulties had been experienced by consumers in consequence of the introduction of the process. They found that no difficulty had arisen, except in one undertaking, in a large district exclusively supplied during the past winter by carburetted water gas, where, owing to the greater specific gravity of carburetted water gas than of coal gas, it had been found to be necessary to make alterations in the capacity of the burners. They also found that where carburetted water gas had been introduced, consumers had experienced much less difficulty than formerly from stoppages in service-pipes by the formation of naphthalene, and that, in fact, this difficulty had in such places almost entirely disappeared. There is, say the Committee, no direct saving in the production of water gas; but the process has many advantages. The plant can also be provided at a much lower capital expenditure than coal-gas plant, capable of producing an equal output. There is a further important consideration as regards the gas-works of the Corporation. At Adderley Street the whole, and at Saltley a portion, of the present coal-gas plant cannot without reconstruction be adapted to the development of labour-saving appliances or to modern methods of gas manufacture; and sooner or later it will be necessary to undertake the reconstruction of the whole or a portion of this plant on modern lines. As this will involve the laying by of a considerable portion of the plant over some period, it would be a great advantage to have carburetted water-gas plant available during such work of reconstruction. At the time when the inquiries which have been referred to were undertaken, it was estimated, on the average increase of the output in recent years, that the surplus productive manufacturing power would not be exhausted before 1897. It was, however, shown by the large output in the week ending Dec. 19 last, when the weather was mild and light for the season, that it would be no longer safe to rely on this estimate. In that week the output of gas from the three Birmingham works reached 132,402,000 cubic feet, or within a million cubic feet per day of the productive capacity. It was, therefore, apparent that, for the purpose of reasonable safety, an addition must be made to the manufacturing plant before the winter of 1896. After full and careful consideration of the position, the Committee have authorized the construction at the Saltley and Windsor Street works of carburetted water-gas plant equal to the production of 2 million cubic feet per day at each of these works. The plant will be required for the immediate necessities of the undertaking; but the Committee are providing, in the construction of the buildings for it, room for additional plant for a further production of 4 million cubic feet per day at the two works, so as ultimately to bring the total production to one-third of the output of coal gas. It has been found in working elsewhere that this limit cannot be exceeded without requiring modifications in the distributing plant. The Committee have authorized an expenditure not exceeding £60,000 in the provision of this addition to the manufacturing capacity.

The Committee have ascertained that, at several of the larger gas undertakings in the country, plant has been successfully applied for the recovery of cyanogen from coal gas. After careful inquiry into the matter, they have authorized the expenditure of £1750 at the Saltley works in the construction of plant for this purpose, and in connection with this have accepted the tender of Messrs. Kirkham, Hulett, and Chandler for the necessary washers at a cost of £1020. The plant at Saltley will be equal to dealing with the minimum summer make of 3½ million cubic feet per day, so as to keep the plant fully employed throughout the year. If the present demand for this product is maintained or increased, the Committee propose to extend the plant, so as to make it capable of dealing with the whole production at Saltley, and will also provide plant for dealing with that at the other works.

After reference to several matters of minor importance, the Committee report that they are making satisfactory progress with the issue of prepayment meters, which was resumed after the winter pressure on the fittings department had ceased. At the outset, they undertook to fix meters for any qualified applicants desiring to become consumers; but having regard to the fact that, if these meters are to be made remunerative, it can only be by the exercise of very close economy in their supervision and management, they are now only accepting orders for them in streets in which they have already been fixed, or in which there are six or more applications made for them.

The balance-sheet and statement of accounts show a profit for the year ended March 31 last of £25,000; and the Committee recommend that this sum be appropriated to the improvement rate of 1895. They also estimate that the profit for the present year will be £25,000, in addition to the interest on the reserve fund. The manufacture of gas, omitting shillings and pence—including cost of coal, carriage, unloading, &c. (£230,972), purifying materials and wages (£13,243), salaries of engineers, superintendents, and officers at works (£5548), wages at works (£55,097), repairs, maintenance, renewal of works, plant, &c. (£90,863)—totalled up to £395,724; the distribution of same, repairs and maintenance of mains, &c., cost £36,917; public lamps, £3045; rents, rates, and taxes, £25,569; management expenses, Secretary's salary, Accountant, collectors, general establishment charges, &c., £9847; other incidental expenses bringing the total expenditure up to £472,847. The sale of gas, including public lighting and under contracts, less discount and adjustments, produced £476,907, against £490,847 in 1895; and residual products (including coke and breeze £59,640, tar £25,000, ammoniacal liquor £29,591, sundries £61) yielded £114,294, against £140,475 in 1895. Other items on the credit side bring the total income up to £597,282, against £636,412 in the previous year, and show a gross profit on the twelvemonth of £124,434, to which has to be added interest allowed by bank and dividends £1451. Of this profit, a sum of £54,038 is absorbed in annuities, £19,311 in interest on Corporation 3½ per cent. stock, £4679 in interest on mortgages and bonds, £5675 in interest on sinking fund, £12,963 in interest on amount applied in redemption of loans, and £4217 an instalment for redemption of loans and annuities—leaving, as already stated, a net profit of £25,000. A year ago the sum so voted amounted to £30,448; but, as will be seen from the figures quoted, the profits from residuals in 1895 were £26,000 more than those for the year just ended.

The following statistics are for the half years ending March 31, 1896 and 1895 respectively: Sale of gas, 2,904,242,000 cubic feet, as against 2,814,020,000 feet, or an increase of 3¼ per cent. The new services connected numbered 1960, as compared with 1229. There were 69 gas-fires fixed, as against 42; 210 cooking and heating stoves were hired, in comparison with 177; and the number sold was 363, against 319. The quantity of coke in stock was 4463 tons, compared with 11,464 tons. The cost of the repair of meters for the entire year was £7359; and the number repaired was 9370.

PARIS GAS COMPANY.

The Report and Accounts for the Year 1895.

The following is an abstract translation of the report of the Directors of the Paris Gas Company for the past year, with the principal items in the accounts for this period.

The quantity of gas sent out last year for consumption in Paris and the 59 neighbouring communes served by the Company was 311,023,400 cubic metres, or about 10,979,126,000 cubic feet; being 10,199,690 cubic metres, or about 360,049,000 cubic feet, more than in 1894. In the three preceding years, there had been a falling off in the consumption. The substantial increase above recorded is therefore all the more gratifying; and the Directors remark that there is every reason for believing that this upward movement will continue. The principal causes of the diminution in the consumption above referred to were the extended employment of electricity as an illuminant, and the more general use of incandescent and high-power gas-burners. But the application of electricity to lighting purposes is now developing but slowly; and though the adoption of improved burners caused a temporary drop in the quantity of gas consumed, it secured to the Company a great many consumers, and even brought back others to whom electric lighting did not offer any advantages, on the score either of illumination or expense. The Directors state that the greater part of the increase in the consumption of gas last year was attributable to the system they have introduced, with the concurrence of the Municipality, of exonerating from the expenses incidental to furnishing a supply of gas, all occupants of apartments of less than 500 frs. annual rental. This liberal measure has brought in a large number of new customers who but for it would not have taken a supply of gas; and this is employed not only for lighting, but for general domestic purposes, as the Company place at their disposal appliances suitable to their requirements. The gas consumed in this way constitutes a very important part of the day supply, which last year reached 94,230,540 cubic metres, or about 3,326,338,000 cubic feet, as compared with 87,427,180 cubic metres (3,086,180,000 cubic feet) in 1894. This difference of 6,803,360 cubic metres is equal to more than 67 per cent. of the total increase in the consumption of gas recorded in the past year. The proportion of day gas to the total supply has risen from 29·06 to 30·29 per cent. The receipts from the sale of gas amounted last year to 78,757,716 frs. (£3,150,309), of which 71,841,107 frs. came from the city, and 6,916,609 frs. from the surrounding districts. The total is higher by 1,659,166 frs. than it was in 1894. The number of consumers on Dec. 31 last had risen by 37,936—an absolutely unprecedented augmentation—of whom 6240 were of the ordinary class, and 31,696 were those who had become customers of the Company under the new arrangement. These additions brought up the total from 281,217 at the close of 1894 to 319,153 at the corresponding period of 1895. The number of cooking-stoves lent gratuitously also notably increased—having risen from 174,947 on Dec. 31, 1894, to 214,386 at the end of 1895. There were 1503 more new stoves sent out than there were fresh customers; thus affording a striking proof that the advantages of these appliances are appreciated. The number of public lamps in use on Dec. 31 last was 89,943, as compared with 85,968, of which 77,513 were employed in lighting the city. In 1894, only 73,763 lamps were in use in the city; and the increase of 3750 is owing in a measure to the installation of a number of recuperative burners at the sections of important thoroughfares, in open spaces, and in the principal streets. The number of rising mains fixed during

the past year was 2421—being about twice as many as in 1894. This brought up the total at the end of the year to 40,000, fitted in 30,806 houses; and 190,054 consumers, or 36,499 more than in 1894, obtained their supply by this means. These consumers now represent 59·55 per cent. of the entire number. All this is the outcome of the introduction of the new system of supply previously alluded to; and its application has been facilitated by the premiums offered by the Company to makers of gas appliances, who are always on the look-out to secure fresh customers, and promptly satisfy their requirements. The Directors, on their part, are fully alive to the necessity of being prepared to continue a system which is advantageous alike to the City, the Company, the consumers, the manufacturers, and their employees. With regard to the works and plant, no noteworthy change was made in the manufacturing capacity of the various stations; but, of course, the mains were extended to meet the increased demands upon them. In the city, 12,416 metres, and in the suburbs 10,614 metres of mains were laid—making together 23,030 metres, or about 25,180 yards. This addition brought up the total length of mains at the close of the past year to 2,379,022 metres, or about 1478 miles.

Turning to the financial section of the report, we find that a net sum of 7,755,934 frs. (£310,237) was expended last year for capital purposes, the greater part of which was for rising mains, service-pipes, and meters. The capital account stood as follows on Dec. 31, 1895:—

	Francs.		Sterling.
Amount expended to Dec. 31, 1894	298,285,072	..	£11,931,403
Do. do. during 1895	7,755,934	..	310,237
Total	306,041,006	..	£12,241,640

To meet this there has been raised: By shares, 84,000,000 frs.; by bonds, 221,185,689 frs.—together, 305,185,689 frs. (£12,207,427) The capital account has therefore been overdrawn to the extent of 855,317 frs. (£34,213). There is, however, a sum of 16,650 frs. remaining to be paid upon bonds. The capital is represented by 336,000 shares and 473,332 bonds. Up to the date of the report, there had been redeemed 175,775 shares and 208,407 bonds; so that 160,225 shares and 264,925 bonds remain to be redeemed before the expiration of the concession in 1905.

The following is the working account for the past year:—

Expenditure.

	Francs.		Sterling.
Value of gas in store on Jan. 1, 1895	49,630	..	£1,985
Manufacture of gas—			
Coals carbonized	20,208,501	..	808,340
Coke and tar for heating purposes	4,306,825	..	172,273
Salaries and wages	4,826,196	..	193,048
Maintenance of works and plant	1,456,243	..	58,250
Incidental expenses of carbonization	1,405,284	..	56,211
Purifying materials and labour	359,390	..	14,376
Distribution—			
Salaries of engineers and officers	2,139,819	..	85,593
Repairs, &c., of mains and services	1,458,154	..	58,326
Miscellaneous expenses, stamps, &c.	479,866	..	19,195
General management (including interest and sinking fund payments)	22,998,780	..	919,951
Pension and provident funds	1,593,151	..	63,726
Municipal charges—			
Tax of 2c. per cub. met. of gas sold.	5,313,205	..	212,528
Rent of subsoil occupied by mains,&c.	200,000	..	8,000
Lighting, extinguishing, and maintenance of public lamps (less amount paid by Municipality)	1,205,108	..	48,204
State charges—			
Official gas testing, stamps, &c.	1,105,530	..	44,221
Total expenditure	69,105,682	..	£2,764,227

Revenue.

	Francs.		Sterling.
Value of gas in store on Dec. 31, 1895	58,550	..	£2,342
Sale of gas	78,757,716	..	3,150,309
Residual products—			
Coke	11,485,877	..	459,435
Tar	1,989,988	..	79,600
Ammoniacal liquor	1,476,401	..	59,056
Rental of meters and fittings on hire	3,299,024	..	131,961
Fire-bricks, &c.	63,610	..	2,544
Interest and discount	739,428	..	29,577
Total revenue	97,870,594	..	£3,914,824
Deduct expenditure	69,105,682	..	2,764,227
Balance, profit for 1895	28,764,912	..	£1,150,597
Add balance of 1894 liquidation	197,064	..	7,882
	28,961,976	..	£1,158,479
Deduct to meet outstanding claims	261,976	..	10,479
Balance available for distribution	28,700,000	..	£1,148,000
Deduct for share dividend	11,200,000	..	448,000
Balance, divisible equally between the Company and the Municipality	17,500,000	..	£700,000

The total amount available for distribution among the shareholders is therefore as follows:—

	Francs.		Sterling.
Dividend as above	11,200,000	..	£448,000
Half of divisible balance	8,750,000	..	350,000
Placed to shareholders' credit, as per resolution of March 23, 1875	50,000	..	2,000
Balance of undivided profits	136,784	..	5,471
Total	20,136,784	..	£805,471
Deduct 1 fr. per share for reserve fund.	336,000	..	13,440
Balance	19,800,784	..	£792,031
Deduct interim dividend of 12 frs. 50 c. per share paid in October last	2,154,463	..	86,178
Balance available for final dividend	17,646,321	..	£705,853

The balance allowed of a further payment of 52 frs. per share (£10); making in all 64 frs. 50c. per share, and leaving 174,321 frs. (£6973) to be carried forward. The dividend is higher by 2 frs. than it was for the preceding year, and 50 c. higher than it was in 1893. There was a special reason for the falling off in 1894, which was explained in the Directors' report last year.

With regard to residuals, the sale of coke produced 584,878 frs. (£23,395) less than in 1894, owing to the low rates prevailing. The drop, however, was not nearly so great as it was in 1894, when the amount received was 2,305,408 frs. lower than in 1893. The exceptional price obtained for sulphate of ammonia in 1894 was not maintained last year; and there was a substantial reduction in the sum realized by the sale of chemical products. Compared with 1893, however, the receipts from these sources were really higher.

The sale of gas heating appliances continued in the past year brisk; the number sold being 1223—an increase of 177 on the preceding twelve months. These are stoves constructed according to the Company's patterns; but, of course, they only represent a proportion of those in use by the consumers, a number of which are furnished by other makers. The increased employment of gas for domestic and industrial purposes in Paris has been brought about in a large measure by the show-rooms which the Company have opened in several parts of the city. No fewer than 60,377 visitors last year sought information at these establishments as to the best appliances for lighting, heating, and the production of motive power; and the number of orders executed reached 8867, as compared with 7518 in 1894. Important assistance is rendered by the lectures on cookery which are given at various places on both sides of the Seine, as well as by the activity displayed by the Company's outdoor agents in calling upon possible customers. Domiciliary visits were paid by these officers to 8362 persons at their request, in order that information might be imparted as to the best way of using gas. In 1894, the number of such visits was 7663. But the Directors anticipate, so to speak, these applications for advice, and at the same time facilitate the labours of their agents, by distributing freely at the commencement of the winter season, a quantity of printed matter furnishing particulars as to the improvements effected since the previous winter in the construction of the various types of appliances on view in the Company's show-rooms. All these measures have contributed in a very notable degree to bring about the increased consumption of gas which the Directors have the gratification of recording for the past year. The number of coke-heating appliances sold last year was 1854; being an addition of 372 to the sales in 1894. This was attributable to the low price of the fuel and a reduction made in the price of the stoves for utilizing it.

With respect to the use of gas for motive power, there were fitted up, in the twelve months ending Dec. 31 last, 214 engines, representing 1197-horse power as compared with 196 engines, representing 830-horse power in 1894. Engines of 25 and 50 horse power are every day coming more into use, not only by small manufacturers, but in public buildings for the production of the electric light. An interesting application of gas as a motive power is for the working of lifts. An establishment in Paris has lately fitted up an appliance which is stated to be more economical than the old lift actuated by water at high pressure. There should be room for an extension in this direction. Then there is the use of gas for driving tramcars, which is competing with the other systems in Paris. The Directors remark that this method of traction presents such advantages that they hope to see it adopted on a portion of the urban and departmental lines.

The report furnishes, as usual, full particulars in regard to the provident, pension, and other funds connected with the Company. The Directors give the greatest attention to everything that can possibly improve the position of their employees generally. The allocation to the workmen of a sum equal to 2 per cent. on the profits for the year 1894 produced a total of 554,000 frs. in the past year. This amount has been distributed; and it represents an addition of about 33c. per day, whatever may be the rate of pay. The men who worked for the Company all through the year thus received, in a lump sum, by way of bonus, upwards of 120 frs. Beyond this general advance in the remuneration of the employees, the retort-house men have now a minimum rate of wages of 42·5c. per hour, which, with the coke gratuitously distributed to them, supplemented by the 2 per cent., brings up their pay to more than 5 frs. per day of ten hours.

Towards the close of the report, reference is made to the subject of the price of gas. Early in December last, the Municipal Council expressed favourable opinion upon a proposition submitted by the Directors to the Prefect of the Seine to reduce by 2·5c. and 5c. per cubic metre respectively the price of gas supplied for the public and private lighting in certain communes. It was thought that the proposal would be advantageous to all parties concerned, and that the reduction in price would lead to increased consumption which would in the near future compensate for the initial sacrifice. This would not exceed 400,000 frs. per annum during the first years; and it would be borne equally by the Company and the city—the former, however, being granted permission to lay their mains under less onerous conditions than hitherto. The authorities of nineteen communes were approached on the matter. Eight of them agreed; and the consent of the others was expected at the time the report was issued. By virtue of the new arrangement, four of the communes (Aubervilliers, Charenton, Pantin, and St. Ouen) pay, as from the 1st ult., 15c. and 30c. per cubic metre for the gas supplied for municipal and private lighting; while the other four (Arcueil-Cachan, Joinville-le-Pont, Nogent-sur-Marne, and St. Maur-les-Fossés) pay 17½c. and 35c. per cubic metre respectively.

Marsden District Council Gas Department.—The annual report of the Gas Manager (Mr. F. Lee) was presented to the Marsden District Council at their last meeting. The figures showed that there had been an increase of 12 per cent. in the quantity of gas sold as compared with last year, and 32 per cent. in comparison with 1894. The gas sold per ton of coal was 191 cubic feet more than last year; and 114 cubic feet more than in 1894. The total expenditure for the year was £2124; and the receipts, £2417—leaving a net balance of £292. The expenditure includes the cost of a new retort-bench and mains; also the repayment of loans and interest, and £68 for meters.

BOMBAY GAS COMPANY, LIMITED.

The Ordinary Meeting of this Company was held last Thursday, at the London Offices, 6, Drapers' Gardens, Throgmorton Avenue, E.C.—Mr. R. DAVIDSON in the chair.

The SECRETARY (Mr. J. H. Perrins) read the notice convening the meeting; and the report and accounts for 1895, of which a summary appeared in the "JOURNAL" for the 5th inst., were afterwards taken as read.

The CHAIRMAN said the first thing he had to do was to congratulate the shareholders on the Company having secured a new contract for the public lighting of Bombay on the Welsbach system, for ten years from July 1 last. According to this contract, the minimum number of lamps was to be 3250. The present number was 3800; and he thought this figure would be maintained, and perhaps increased. There were two classes of lamps in use—whole and part month lamps; the latter being those burnt on moonlight nights. The terms under the new contract for the whole month lamps are 70 rupees per annum, and for the part month lamps 56 rupees 12 annas. Under the old contract, the terms were 93 rupees and 73 rupees 8 annas respectively; so that there was a considerable reduction. But the Welsbach burners were supposed to burn 3½ cubic feet per hour, as against 5 cubic feet with the old burners; thus saving large expenditure in coal. There was no doubt they would have less revenue from the public lighting under the new contract; but, on the other hand, the Welsbach burner was in great favour. The revenue from the private lighting had increased, and, indeed, was increasing during the present year at a very satisfactory rate. As he had indicated, to get the new contract the Directors had to make a large concession in the price; but still he thought the increase in the private consumption would soon overtake the loss they had sustained by the public lighting. Three months of the year covered by the present accounts had been under the new contract, so that they had already felt some of the effects of it. Looking at the figures in the accounts, on the credit side of the profit and loss account, the gas and meter rental was £957 less: but the private rental was £84 more. The residual products had yielded £297 less; and the fittings showed a falling off of nearly £700, owing to the Welsbach burner allowing the use of single brackets in place of chandeliers. The interest was £426 less; being the result of a smaller amount of money in Bombay. On the debtor side, coal had decreased by £835. They had carbonized a smaller quantity by 200 tons; and the cost per ton was 1s. 8¾d. less. Wages were £198 more; and purifying had increased by £774. This represented a large consumption of lime, which was very costly and inferior in Bombay; but their Manager (Mr. Louis Penny) had now secured a superior material from up country. Trade and general charges were more by £384—the result of an increase in the shipments of sundry stores. Rents, rates, and taxes had increased by £144, arising from income-tax and municipal rates. The loss on exchange was £912 less. In 1895 the Company got their money home at 1s. 1 3/32d.; while in 1894, it was 1s. 1 23/32d. The amount of money remitted last year was 5½ lacs of rupees as near as possible; and the loss on exchange—the difference between 2s. at which their books were made up and the rate obtained—was £24,221. Their Engineer reported that the works were in good condition; and the only outlay he anticipated was a new gasholder, which would probably cost from £2000 to £3000. The Manager stated that the new light was a grand success; and the Chairman of one of the largest provincial gas companies in this country, who had been in Bombay, expressed the opinion that he had never seen any city so brilliantly lighted.

Mr. F. L. LINGING seconded the motion.

Mr. T. S. BORRADAILE, speaking of the loss on exchange, suggested that, instead of calculating the accounts on the basis of 2s. per rupee, 1s. 6d. or 1s. 3d. should be taken. This, he said, would be nearer the actual value, and such an enormous loss as £24,000 would not be shown, though, of course, the result would be actually the same. With regard to the item of purifying, the Chairman had stated that lime was a great expense; and he inquired whether *chunam* was used, or was lime imported.

Mr. C. GANDON: *Chunam* is lime.

The CHAIRMAN stated that lime was not imported into Bombay; they obtained it there.

Mr. CUFF, although sorry to see several increases in the items of expenditure, expressed general satisfaction with the position of affairs. He did not look upon the decrease in the public rental as a serious matter, seeing that no doubt it was due to the adoption of incandescent lighting, which would be of material assistance to the Company in competing with the electric light and oil. He agreed with Mr. Borradaile that perhaps it would be better to calculate their accounts at a lower rate than 2s.

Mr. W. WHITLEY said he understood that the contract for the public lighting was at a considerably less price than that entered into in 1893, and yet there had since been a reduction in the value of the rupee. He did not see that there would be the slightest advantage in altering their system of bookkeeping by calculating the rupee at 1s. 6d. All the Company's transactions on 'Change were carried out at 2s. per rupee.

The CHAIRMAN pointed out that all the Eastern banks kept their books at 2s. per rupee; and if there had been any pressing reason for an alteration, the banks would certainly have adopted it. As to the new contract, of course it was assumed that the Welsbach burner would only consume 3¼ or 3⅓ cubic feet of gas against 5 cubic feet under the old system; and that necessarily caused a difference to be made in the price.

The motion was unanimously carried.

On the proposition of Mr. GANDON, seconded by Major W. F. GORDON, the Chairman was re-elected to his seat at the Board, as was also Mr. Frederic Lane Linging, on the motion of Mr. H. E. JONES, seconded by the CHAIRMAN.

The Auditors (Messrs. E. A. Flinders and Magnus Ohren) were next re-appointed.

The proceedings terminated with the usual acknowledgment of the services of the Chairman and Directors and officers.

SINGAPORE GAS COMPANY, LIMITED.

The Annual Meeting of this Company was held last Thursday, at the Cannon Street Hotel, E.C.—Mr. SAMUEL SPENCER in the chair.

The SECRETARY (Mr. R. M. Christie) read the notice calling the meeting; and the report and accounts, to which allusion was made in the "JOURNAL" last week, were then presented.

The CHAIRMAN, in proposing their adoption, said it afforded the Directors the greatest possible pleasure in being able to propose the small dividend now recommended, as the Company were entering the list of dividend-paying concerns after being three years without any return on the capital. They were sanguine that they would be able to maintain, if not increase, the percentage now offered. Since the last meeting, the rate of exchange had improved in their favour from 2s. 1⅛d. to 2s. 2¼d.—the average rate for the half year under review. They had also purchased their coal at about 1s. per ton less, besides which the carbonizing had been very good—resulting in a make of about 10,000 cubic feet of gas per ton. The sales of gas for the half year had amounted to 19,605,000 cubic feet, which was something like 550,000 feet more than in the previous half year. The increase was small; but the Directors considered it fairly satisfactory, as it was the best they had had for three years. They were hopeful this would continue, as there was every indication of it doing so. The profits were, however, small—considerably too small in the Directors' opinion as a return for invested capital in a foreign country; and the question arose whether now was not the time to ask their new Manager if he could not endeavour to arrange an increase of price. During the past half year, they had secured fourteen new consumers. This he mentioned with much satisfaction, as it was the first time there had been an addition for several half years. The public lamps had increased by 19; making the total 1030. The accounts had been as usual closely collected; and the bad debts amounted to the surprisingly small sum of £1 14s. 9d. Immediately after the last meeting, the Directors paid off the old loan of £960, and now presented a balance-sheet free from loans or debts, except for current accounts, and these were less than at any time during the last fifteen years. The revenue was about the same; and the net profit was, in round figures, £800. The Directors had written off £354 for depreciation of works, and £801 had been used in writing down the amount due from gas and meter rentals. Hitherto, in carrying out this item, the dollar had been taken at 4s. 6d. But this half year the sum had been carried out at 3s.; and the Directors hoped next half year to figure the item out at the current rate of exchange. After these reductions, it left about £600, which, added to the amount brought forward from last year (£1089), gave a net balance of £1687, from which was recommended a dividend at the rate of 3 per cent. per annum, free of income-tax; leaving about £700 to be carried forward. Since the last meeting, the Board had appointed Mr. Albert Ford as the new Manager. There were 50 applicants for the post; and the Directors felt confident they had made a good choice, as Mr. Ford had had good experience, and had most successfully carried on the affairs of the gas-works of the City of Santos during his engagement. He arrived at Singapore early in March, and took charge of the works on the 28th of that month. Mr. Smith left Singapore on March 30; and they had the pleasure of his presence at the meeting. Immediately after Mr. Smith had sailed, the stokers sought an interview with the new Manager, and demanded an increase of pay; and, as he would not submit, they all turned out. He thereupon engaged such men as were available; and he with the staff worked with them as well as they could for 48 hours. Thinking, however, it would be better in the interest of the consumers and the Company that the men should be reinstated, he called them in again, and arranged such terms that they commenced work. The additional cost to the Company would be under £100 a year.

Mr. W. T. BATTEN, in seconding the motion, said the Directors had every reason to believe—though, of course, they could offer no guarantee—that the dividend they now had the pleasure of proposing would be continued, and, they hoped, increased. Exchange, they believed was as low as it possibly could go. Looking back over the past five years, it would be found, taking the December half years only (which were a good criterion of the whole year), that, during the six months ending Dec. 31, 1891, the loss on exchange was £2442; 1892, £2278; 1893, £2475; 1894, £3594; 1895, £4626. While this enormous loss had been going on, the sundry creditors had been reduced year by year. At the end of December, 1891, the item stood at £8592; 1892, at £5775; 1893, at £3110; 1894, at £1945; and 1895, at £1221. On the other side of the balance-sheet, they had cash which more than made up for the £1221. These figures showed that, while the loss on exchange had greatly increased during the last five years, still, in spite of that tax, the Company had paid off sundry creditors to the amount of £7381. Their Secretary had worked out the loss on exchange; and his figures showed that at June, 1893, the value of the dollar was 2s. 9 1/16d.; while now it was only 2s. 2¼d. This all showed that a great deal had been done by the Directors; and they were still on the same tack.

Mr. T. A. GREENE questioned the wisdom of again raising the price of gas, seeing that it was increased so recently as June, 1894.

The CHAIRMAN said his allusion to the price of gas was intended only to refer to the Municipality, who were desirous of introducing incandescent lighting. In consequence of an experiment they had been making, the Company's revenue had suffered by about £100 in the past half year; so that, if the system was extended to the whole of the lamps, it would form a considerable item, unless they received a better price for the gas.

Mr. ROBBINS pointed out that, although it was predicted when they last raised the price of gas that it would be most disastrous, they had increased the number of their customers somewhat; and he could not see any method by which they could obtain a fair return on the capital except by a further increase in the charge.

Mr. H. W. SMITH (the late Manager) was of opinion that it would be a dangerous step to increase the price to the consumers.

Mr. SIMMELKJÖR disagreed with Mr. Smith. Experience in the case of four or five other foreign companies showed him that, although

there was some outcry when the price of gas was increased, and customers left them, they soon returned.

Mr. DYER considered that the public lighting was too cheap; and he urged the Directors not to increase the price to private consumers.

The CHAIRMAN, in closing the discussion, stated that the Company were now lighting the hospital at Singapore; and this would give them a good addition to their revenue. They had also certain other new connections in view; so that their prospective increase was very fair for the current half year. Whatever increase was made, he hoped something would be put to a reserve fund.

The motion was unanimously carried.

The dividend recommended having been declared,

On the motion of Mr. B. GREEN, seconded by Mr. T. INSTONE, the retiring Directors (Messrs. Spencer and Batten) were re-elected. The Auditors (Messrs. Ohren and Guyatt) were also re-appointed.

It was next agreed, on the suggestion of the Chairman, that the meetings should in future be held annually, instead of half yearly.

Mr. H. W. SMITH, on the invitation of the Chairman, addressed the shareholders. He said that at the last meeting some remarks were made which, at the time, he felt very much. Mr. Dyer on that occasion referred to the condition of the Company's works; thinking that, because the yield of gas had not been so satisfactory, their state must be very bad. He could assure the shareholders that they had a good property in Singapore, quite equal—in fact, better than—the average works in the same sized towns in England; and, as to the distribution plant, the unaccounted-for gas would give an idea of its excellent condition. They had a good connection; and a number of large consumers—consumers much more substantial than they had been accustomed to. Their bad debts for the last half year showed that the customers were not of a poor class. They had had some twelve months' experience of incandescent gas lighting in Singapore. The lights had been fitted to 100 public lamps; and the Municipality were very well satisfied with them. If they could only get them introduced, and make them popular, it would mean a new lease for the Company there. The great drawback, however, was the price. Their agent, like most persons in the East, was not satisfied with a little profit; and he (Mr. Smith) was sorry the Company had not the agency in their own hands. The price of the mantles alone was something over 3s.; while here they could, he believed, be obtained for about 1s. He proceeded to speak of the improvement in the business since 1890–91, previous to which time there had been a gradual decline. In 1895, they sold 6,792,000 cubic feet more gas than in 1890. In 1891 the revenue was $94,479; while in 1895, it was $114,865. This was a large increase; but unfortunately they had had the serious fall in the rate of exchange. Although not shown on the balance-sheet, a larger profit had been produced than the Manager had had credit for.

Mr. DYER said he was sorry if he hurt Mr. Smith's feelings by what he said at the last meeting. When he saw the diminution in the yield of gas, his first impression certainly was that the works had been allowed to run down; but Mr. Green afterwards explained that it was due to inferior coal and to trouble with the stokers.

Votes of thanks were then passed to the Chairman and Directors and to Mr. Ford, the Secretary, and the staff.

GEORGETOWN (BRITISH GUIANA) GAS COMPANY, LIMITED.

The Half-Yearly General Meeting of this Company was held last Tuesday at the London Offices, 30, Gracechurch Street, E.C.—Mr. CHARLES GANDON in the chair.

The SECRETARY (Mr. S. Wood, F.C.A.) having read the notice calling the meeting, it was agreed to take as read the Directors' report and accounts for the six months ending Dec. 31 last, to which reference was made in our issue for the 5th inst.

The CHAIRMAN, in moving the adoption of the report and accounts, said it would be seen that the Directors did not propose the declaration of a dividend upon the ordinary share capital for the period under consideration. It was with much regret that they had come to this decision, as they had hoped the accounts would have been such as to admit of a dividend being proposed. But, unfortunately, this was not the case, although it was true that the revenue balance was £315, as compared with £299 for the half year ending June 30 last, on which occasion a dividend at the rate of 2 per cent. per annum was declared. In order to pay this dividend, however, it was necessary to trench on the reserve fund; and though this was one of the objects of the fund, the Directors did not consider it prudent to draw upon it continually. At the last meeting, he stated that they were endeavouring to effect economies in the expenditure at Georgetown. This had been done to a considerable extent; but he must confess he was disappointed that more had not been accomplished in that direction. Taking the balance-sheet and comparing it with the half year ending June last, it would be found that wages were £34 less; repairs, £246 less; salaries, £68 less; and trade and general charges, £33 less. On the other hand, however, coal had cost £25 more. This was due to a small deficiency being found in making up the stock, for which provision had had to be made. He was sorry to say bad debts and allowances showed an increase. But, on the whole, the expenditure had decreased by £286. Therefore, if the credit side of the revenue account had remained even the same as last half year, this decrease would have admitted of a dividend being declared. But, unfortunately, on the credit side there was a falling off of £271—principally, of course, in the gas and meter rental. This was partly due to the loss of several good consumers, and also to reductions having had to be made in the price of gas to some public buildings. If these reductions had not been made, the Company would probably have lost their custom also; and therefore the Board considered, although it involved a sacrifice, they had better make a concession. With regard to the future, he was almost afraid to say anything, as he feared there was no great prospect of any material improvement for the present. The competition with the electric light and mineral oil was so keen that they had a difficulty in retaining consumers, and a still greater difficulty in getting fresh ones. In a warm climate like that of Demerara, many people preferred the electric light on account of its comparative coolness, though it cost more. Taking all circumstances into consideration, they must not be too sanguine about making any great improvement. But at the same time, incandescent gas lighting was making good way in Georgetown; and the Company had also a fair prospect before them with regard to the prepayment system of gas supply. The rental from prepayment meters for the month of August amounted to £14, while for December it was nearly £32; and he had no doubt by this time it was considerably more. The extension of this portion of their business seemed to be guided by the rate at which they carried out the orders; for their Manager (Mr. T. B. Younger) informed them that he had a number of applications now on the books. The installation of these fittings and meters entailed a considerable outlay; and the Directors therefore did not think it advisable to proceed too quickly, until they had satisfied themselves that the system was likely to be of permanent benefit to the Company. Of course, business in Georgetown was, and had been for a long time, in a very depressed state; and whether or not the boundary question would have any effect upon it, it was scarcely possible to say. However, the depressed condition had much to do with their own progress, or rather their non-progress. Gas-stoves for cooking purposes did not seem to find favour in Georgetown. They had done everything they could to push them; but people would not have them. Probably the high price of gas was one reason for this. Charcoal was the principal fuel used. It was economical; and servants seemed to prefer it to gas for cooking. Another point he might mention was that the contract for the public lighting of the town by electricity expired this year; and the Directors had great hopes of getting back a considerable portion of this business. With a view to this, their Manager was endeavouring to utilize the incandescent burners for the purpose; and seeing that they were very largely employed both in England and on the Continent for street lighting, he (the Chairman) did not see any reason why they should not succeed. He felt sure if the Company regained the public lighting, the lights would compare very favourably with the electric incandescent burners for the same purpose; his experience being that the latter were quite unsuited for street lighting.

The DEPUTY-CHAIRMAN (Mr. Alfred Lass) seconded the motion, which was unanimously carried.

The CHAIRMAN proposed the declaration of a dividend at the rate of 8 per cent. per annum on the preference share capital (less income-tax, excepting upon the dividends payable to the local shareholders). He remarked that it seemed rather hard to pay the preference shareholders 8 per cent., while the ordinary shareholders obtained nothing. But that was the position of affairs; and the Directors could not help it.

Captain H. THURBURN seconded the motion, which was passed.

Mr. LASS, in proposing the re-election of the retiring members of the Board (Messrs. Gandon and G. Russell Garnett), spoke of the necessity of having a good man at the helm during the troublous times through which they were passing, and such a man they had in Mr. Gandon. As to Mr. Garnett, he was their local Director; and he was very solicitous that the Company should right itself, and assume its normal position.

Mr. MAGNUS OHREN seconded the proposition, which was heartily agreed to.

The retiring Auditor (Mr. H. J. Hartley) was also re-appointed.

On the motion of Mr. R. L. ANDREWS, a cordial vote of thanks was passed to the Chairman and Directors for their services.

The proceedings then terminated.

CAPE TOWN AND DISTRICT GAS COMPANY, LIMITED.

The Sixth Ordinary General Meeting of this Company was held at Winchester House, E.C., last Friday—the Hon. Henry Noel in the chair. The Directors in their report stated that the quantity of gas made last year was 89,952,000 cubic feet; being 12,041,000 cubic feet more than in 1894, with the use of only 42 tons of coal in excess of the quantity carbonized in that year. The coke made was 382,609 bushels, compared with 323,712 bushels; and the tar produced, 59,435 gallons, as against 56,047 gallons. The gas unaccounted for had increased. The amount at the credit of the net revenue, including the balance brought forward, after providing for bad debts and debenture interest paid and accrued, and debiting £3760 to the maintenance of works, was £9498. Out of this, £3000 (being an interim dividend at the rate of 6 per cent. per annum) was paid in October last; and the Directors proposed to reduce the sums standing at the debit of the suspense and preliminary expenses accounts by £2000, and to pay a dividend at the rate of 8 per cent. per annum for the half-year ending Dec. 31 last. This would absorb £6000, and leave £498 to be carried forward. In moving the adoption of the report, the Chairman said the Directors hoped to be able to maintain the present rate of dividend; and there were several things in their favour—the large increase in the consumption of gas and the reduction of their debt, among others. On the other hand, they had certain drawbacks, especially their large accumulation of coke, and the extraordinary amount of their unaccounted-for gas—upwards of 20 per cent. They heard that their old mains were laid at a very shallow depth, and that they had therefore become damaged, causing the heavy leakage mentioned. Both these matters had the Directors' care; and no doubt they would gradually be altered for the better. Mr. J. Boustead seconded the motion; and it was carried.

SOUTH AFRICAN LIGHTING ASSOCIATION, LIMITED.

The Seventh Annual General Meeting of this Association was held at the London Offices last Thursday—Mr. W. Woodall, M.P. (in the absence, through illness, of the Chairman, Mr. D. Ford Goddard, M.P.), presiding. In moving the adoption of the report and accounts, noticed in the "JOURNAL" last week, the Chairman remarked that the event of the past year had been the opening of the Grahamstown works; and he thought the proprietors would be pleased to learn that a profit had been earned on this extension of the undertaking. Although a considerable portion of it had been derived from fitting work, the Directors were satisfied with the result. The decrease in the sale of gas at Port

Elizabeth did not trouble the Directors, as it was due to the introduction, by the Association themselves, of incandescent burners in a country where, owing to the climate, everyone was anxious to use as little gas as possible. It said a great deal for the future of the undertaking that these burners had been largely adopted. The proposed new concessions had not yet resulted in business; but the expenses attending Mr. H. Woodall's visits to several small towns on behalf of the Association had not been incurred in vain, as he believed ultimately the lighting of other towns would be secured. Mr. James Mansergh seconded the motion, and spoke appreciatively of Mr. Woodall's services. Mr. Corbet Woodall quoted from recent reports of local officials to show that the confidence of the Directors as to Port Elizabeth was justified, inasmuch as the consumption of gas had increased considerably as compared with the early part of last year. The report was adopted; and a dividend of 8 per cent., with a bonus of 2 per cent., was declared for the past year, subject to the deduction of the interim dividend of 2½ per cent. already paid. The Directors and officials were thanked for their services; and the remuneration of the former was increased by £200 per annum.

THE ROPE-GUIDED GASHOLDER AT MIDDLESBROUGH.

Sinking of the Tank.

At the Meeting of the Middlesbrough Town Council last Tuesday, the minutes presented by the Gas Committee contained the following remarks in reference to the tank of the rope-guided gasholder completed towards the close of last year, and described and illustrated in the "JOURNAL" for Nov. 26 (p. 1088): "When the tank was first filled with water in October last, it sank on an average 3¾ inches; the four points taken varying from 2⅞ to 5 inches. Since that time, the sinking has continued equally; the tank sometimes remaining at a stationary level for weeks together. The position of the tank is now about 12 inches lower than when erected. As these sinkings have caused the tank to slightly alter its shape, the guides require to be readjusted during the summer; and for this purpose the water must be run out, so that the makers can do the necessary work." In moving the adoption of the minutes, the Chairman of the Committee (Mr. Alderman Hugh Bell) dealt in very caustic terms with some remarks recently made in the local papers on the position of affairs; and he then proceeded to explain the paragraph from the minutes quoted above. He said that when the tank was erected, it was found that, with a diameter of 182 feet, it was between 1 inch and 2 inches out of the true level. The weight of the tank was 24,000 tons, and it sank almost regularly about 3¾ inches. It was simply like squeezing water out of a sponge; and when it had been squeezed out, the tank could subside no farther. In seven months, the tank had gone down as nearly as possible perfectly level; and it was going down now at the rate of ¼ inch per week. The position of affairs could hardly be made more satisfactory than it was. They put down the tank upon a very doubtful and difficult foundation; and the man who expected it to stand absolutely true would be what no member of the Corporation was—a fool. It was perfectly certain that it would subside; but that it should do so with such little irregularity was most surprising. All the "song" that was being made about the danger to the gas-tank and the disastrous state of affairs on the Marshes, was nothing more nor less than pure moonshine. The tank was in an entirely satisfactory condition; and if it were not, they would have to remedy it, because it was no use meeting their troubles half way. The blocks for the columns had tilted; and members could imagine what the result would have been if they had had a column-guided holder. He would not have troubled them with the matter if he had not felt that people were beginning to get alarmed. The rope-guided holder was working entirely satisfactorily; and they need have no sort of fear as to the way in which it would behave in future. If they had had a tank surrounded by columns, these would have been standing in all directions, and would have been jamming the tank; and they would have had a very expensive job. A column-guided holder with a sunk tank would have cost a great deal more than the rope-guided one. Mr. M'Lauchlan seconded the motion. Alderman Buller asked why, if Alderman Bell knew the tank would sink, steps were not taken to prevent it doing so. They had 3 or 4 feet of concrete on the bed of the tank, and it had practically cut through this. If they had had a tank like the first one, they would not be in the difficulty they were at the present time. No blame attached to the constructors (Messrs. Ashmore, Benson, Pease, and Co.), who had done their work well. The fault was in the foundation. If it had not been for the Chairman, they would have had a brick tank. Mr. Hedley pointed out that the majority of the Council were averse to having one. Alderman Bell said such a tank would have been a great deal more expensive. He had thought it well to let the Council know that the alarming reports circulated were substantially without foundation. The whole thing, as presented in the papers, was a case of grotesque exaggeration. The work required to be done to put matters right would only cost £50. The minutes were adopted.

SALES OF SHARES.

Mr. Alfred Richards held a very successful sale of stocks and shares in gas and water undertakings at the Mart, Tokenhouse Yard, E.C., on Monday last week. Some £10 "D" preference shares, 6 per cent., fully paid, in the Aldershot Gas and Water Company, realized an average of £17 3s. 4d. per share. £150 of consolidated old stock of the Commercial Gas Company, the last dividend on which was at the rate of 13½ per cent. per annum, was knocked down for £339 per £100. Original ordinary consolidated stock of the Brighton and Hove Gas Company, carrying 11 per cent. dividend, was sold at the rate of £300 per cent.; some 6 per cent. "B" preference stock fetching £165 per cent. "B" stock of the Broadstairs Gas Company, on which the last dividend was at the rate of 7 per cent. per annum, but which is entitled to 10½ per cent., if earned, was knocked down at an average of £182 10s. Fully-paid £10 shares in the West Ham Gas Company, carrying 6½ per cent., fetched £16 15s. each. Original 10 per cent. stock of the Worthing Gas Company found purchasers at the rate of £253 10s. per cent.; some fully paid £10 shares (7 per cent.) in the same Company being sold for £17 10s. each. Fully-paid £10 shares in the Southend Water Company fetched £14 15s. apiece. A £300 4 per cent. terminable mortgage debenture of the Bournemouth Gas and Water Company was disposed of for £318; and 21 "B" shares (£10), were knocked down at £19 7s. 6d. each. Original £10 fully-paid "A" shares in the Harrow and Stanmore Gas Company, the last dividend on which was at the rate of 7½ per cent. per annum, were sold for £17 7s. 6d. each; some "B" shares fetching £16 15s. each. The West Kent Gas Company's original £10 shares (with 8 per cent. dividend) were sold for £2 10s. each; the new shares, with £4 paid, fetching £8 7s. 6d. per share. "B" stock of the Tottenham and Edmonton Gas Company (8½ per cent.) was knocked down at £212 10s. per cent. The Clevedon Gas Company's "A" shares (£10), on which 6 per cent. per annum has been paid for the past four years, were sold for £14 5s. each; "C" preference shares fetching £12 10s. apiece. Some 6 per cent. preference stock (5½ per cent. paid thereon) of the Herne Bay Water Company was sold at the rate of £125 per cent. The average yield to the investors, taking the above sale throughout, was 4 per cent.

Yesterday week, Messrs. S. R. Force and Son offered for sale by auction 500 new £10 shares in the Exeter Gas Company, bearing a dividend not exceeding 7 per cent. They were put up in lots of five and ten. For the latter, the following satisfactory prices per share were realized: Two lots, £17 10s.; eight, £17 15s.; seven, £17 16s.; ten, £17 17s. 6d.; one, £18 2s. 6d.; one, £18; three, £17 18s. 6d.; and three, £17 17s. For the five-share lots, the prices per share were as follows: Nine, £17 16s.; two, £17 17s.; fourteen, £17 17s. 6d.; two, £18; and three, £17 15s. The lowest-priced lots went at a premium of 75 per cent.; and the highest-priced at 81¼ per cent. The prices are an advance of £2 to £3 per share on those obtained for similar shares last year.

Last Wednesday, the following shares were sold by auction: Some £5 shares in the Brompton, Chatham, Gillingham, and Rochester Water Company, at £15 10s. and £15 12s. 6d. each; 57 original £5 shares in the Ilford Gas Company realized an average of £14 per share: 73 "B" shares of £5 each (fully paid) in the same Company made an average of £9 1s. each; and 42 similar shares, £9 each. The annual interest on the original shares during recent years has been 10 per cent.; and on the "B" shares, 7 per cent.

At the Corn Exchange, Kettering, last Friday, Messrs. J. Robinson and Son sold by auction 500 new ordinary "B" shares of £10 each in the Kettering Water Company, at the following prices: 60, at £14 15s. each; 140, at £14 12s. 6d. each; 296, at £14 10s. each; 4, at £14 7s. 6d. each. The whole of the shares, which are entitled to a maximum cumulative dividend of 7 per cent. per annum, as from the 24th prox., were disposed of in less than half an hour.

The Gas-Works Purchase Question at Wells.—With reference to this question, the Wells Town Council have resolved (inasmuch as the purchase of the gas-works cannot be carried out without an Act of Parliament being obtained, the cost of which did not enter into the calculations of either party in settling the contract) to promote a Bill in Parliament for the purpose. The Gas Company are to be asked to contribute half the expense.

Southampton Gas Company.—Presiding at the ordinary half-yearly meeting of this Company, the Chairman (Mr. R. C. Hankinson, J.P.), stated that they had increased the sales of gas by 13 million cubic feet in the six months; this being equal to 7½ per cent. on the corresponding half of 1894. The increase for the whole year was 23,350,000 cubic feet, or 6·76 per cent. The Directors had sold £5000 of debenture stock at an average price of £152 17s.; the premiums amounting to £2642 10s. They had also concluded a new contract for coal from June for two years, at a very substantial reduction of the price they had been paying. The works, which had been enlarged, were in good order, and capable in every way of meeting the growing demand for gas. Mr. Paddon seconded the motion, which was agreed to. The maximum dividends were also declared.

Exhibitions of Gas Appliances.—An exhibition of gas cooking and heating stoves, organized by Messrs. Richmond and Co., Limited, was opened at the Public Rooms, Exeter, yesterday week. Large numbers of visitors were attracted throughout the week; and there was a good attendance at the cookery lectures given by Miss Barker. Messrs. W. Parkinson and Co. held a very successful gas exhibition from Monday to Friday last week, in the Assembly Rooms, Handsworth, Birmingham; Miss E. Sanderson giving practical demonstrations on cookery twice daily. Under the auspices of the Reigate Gas Company, Messrs. Fletcher, Russell, and Co., Limited, will have an exhibition of their cooking ranges and other gas appliances in the Public Hall, Reigate, from Tuesday to Friday this week. Cookery lectures will be delivered twice each day by Miss H. Edden.

The Sheffield and Barnsley Corporation Water Bills.—At the meetings of the Sheffield and Barnsley Corporations last week, extended statements were made regarding the settlements arrived at in connection with the above Bills, the general terms of which were given in our "Parliamentary Intelligence" last week. In the course of the speech by Alderman Roley, the Chairman of the Barnsley Corporation Water Committee, he presented the following figures, which had been prepared by the Borough Surveyor (Mr. Taylor), regarding the cost of the original Barnsley scheme and their scheme under the new arrangement—Barnsley original scheme: Mr. Hawksley's parliamentary estimate, £149,585; estimated cost of filtration work, £12,000—total estimated cost, exclusive of expenses, £161,585. Barnsley scheme under new arrangement: Mr. Hawksley's estimate, as above, £161,585; add extra cost, Langsett reservoir, £19,148; estimated cost of Knoll Brook works, £10,000—total, £190,733. Deduct less cost of construction of catch water at Hagg Brook, £18,185; reduced cost of Midhope reservoir, £20,000—£38,185—net estimated total, £152,548. This is an estimated saving of £9037 upon the original scheme.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

I have just seen a summarized report, extending to over a column in the "Glasgow Herald," of the Presidential Address of Mr. W. Foulis, of Glasgow, at the meeting in London this week of the Incorporated Institution of Gas Engineers. You will be dealing with it in your editorial columns; and I, who have only seen it in condensed form, need say no more than that in practical wisdom it seems to be thoroughly worthy of Mr. Foulis. I was pleased to see, too, that, on the principle, I suppose, of giving honour to one of their most deserving citizens, the "Glasgow Herald" devoted a leading article to the subject. It was not contained in the paper—as, indeed, it could not have been—but it must be remembered in connecton with the great advance made in the Glasgow Corporation Gas Department, that a very great proportion of it has been due to the initiative of Mr. Foulis himself, both in management and invention.

I stated a fortnight ago that the Greenock Police Board had resolved to contract for 20,000 tons of coal, at an average price of 8s. 7¼d. per ton. In speaking to the Board on the subject, Bailie M'Innes, the Convener of the Gas Committee, said they had gone into the market at a most opportune time; and the result had justified the step, as the price was somewhat below that of last year. This had been attained solely by their using the oil process for the enrichment of the gas. On the subject of the extensions, which had been sent to a Sub-Committee, Bailie M'Innes said that the Sub-Committee recommended the laying of new mains, at a cost of £530. As to the extension of the retort-bench in the works, they did not wish to hasten the matter unduly; but it was desirable that it should not be much longer delayed. There had been a suggestion that they should consider whether oil or cannel of equal value should be used for enrichment. They had received very favourable tenders for oil; and seeing that they possessed the necessary plant, he thought it would be a retrograde movement on their part to suspend the oil process, and that more particularly when other works were continuing it, and when a neighbouring town, which had been held up on more than one occasion as an example worthy of imitation, had recently resolved to adopt it. The proposals of the Gas Committee were adopted; and it was left to them to further consider the subject of extending the retort-bench. They have since decided to proceed at once with the work. The total outlay on mains and extensions is estimated at £2500.

As to the Peebles oil-gas process, I have this week the further information that, after a careful inquiry into the subject, the Dumfries Gas Commissioners have resolved to continue it. In this town there had been, too, a feeling that the enrichment might be more profitably obtained by using cannel. To determine what should be done, the Gas Committee appointed a deputation to visit places where the process is in use. The report of this deputation was submitted to a meeting of the Gas Commission last week. It was to the effect that, in order to thoroughly test the value of oil as a cheap enricher of gas, they discontinued its use for one month, and used a high-class cannel coal instead, with the result that the cost of manufacture rose nearly 3d. per 1000 cubic feet, while the illuminating power fell from 1 to 2 candles. This result, on a total make of nearly 68 million cubic feet a year, was sufficient to warrant them giving the subject their very best consideration. They visited Peebles, Galashiels, Alloa, and Stirling, and saw the process at work. In all the towns visited, there had been complaints, when oil was first used, regarding the smokiness of the gas. This had been caused by too great enrichment by oil gas, and improper combustion; the burners not being adapted to burn gas of a higher quality than from 28 to 30 candle power. The difficulty had been overcome by the reduction of the quantity of oil used, a better admixture of coal, and a lowering of the candle power, with more perfect combustion; and this resulted in a much brighter and whiter light, and an absence of the smokiness previously experienced. They further made inquiries as to the choking of the burners of the public lamps by naphthalene. But in none of the towns visited had this occurred; and they were assured that there was no such product in oil gas, and that it must arise from some of the coal they had been using. As a result of their inquiries, they were of opinion that, as an economical enricher, the use of oil should be continued; believing that initial difficulties had been overcome there, as they had been elsewhere. They recommended that the best furnace oil be employed, instead of shale or paraffin; that a large proportion of good cannel and shale be used than of the cheaper class of coal; and that the gas supplied should be of the uniform quality of 28 candles. The deputation were gratified to observe that their works were fully abreast of anything they observed elsewhere, and they reflected great credit both upon the Commission for the liberal spirit with which they had adopted all the latest improvements in gas manufacture, and upon the Manager (Mr. Malam) for the intelligence and energy he had displayed in bringing the works to their present high state of efficiency. As regarded the recommendation with reference to the quality of the coal, it may be said that it transpired in the course of the meeting that the Commission, having received tenders for coal at a lower rate than last year, are not taking advantage of them to spend less money, but are getting a better class of coal. The report and recommendations of the deputation were adopted. This report may be taken as a convincing proof of the superiority of oil over cannel as an enricher. It has long been known theoretically; but to Mr. Malam belongs the credit of having tested the matter practically, and verified it.

The proposal which was recently made, that the Town Council of Coatbridge should acquire the undertakings of the Gas Company and of the Electric Light Company, has been defeated. Being a Company incorporated by Act of Parliament, the provision as to lodging accounts with the local authority applied to it, with the effect that the Town Council had in their own hands the means of knowing how the Company stands financially—the want of which is felt in most cases to be a distinct disadvantage. They appointed the Chamberlain of the burgh and one of their own number to report to them upon the accounts of the Company. The report they received was to the effect that the capital account of the Company stands at £50,974, which is £1324 more than the subscribed share capital and mortgages; that the leakage was 20 per cent., as compared with 18·93 per cent. in 1894; and that the net profit last year amounted to £4361. A Committee which had been appointed to consider the whole subject of the municipalization of the lighting of the burgh, reported, as the result of the examination of the Company's accounts, that they had communicated with both Companies. The reply they got from the Company was that it was impossible for the Directors to decide whether, or upon what terms, they would be prepared to sell their undertaking; that a meeting of the shareholders would require to be called for the purpose; but that they would be pleased to have the Council's idea of what they considered the undertaking was worth. The Directors of the Electric Lighting Company appeared to be eager to sell their undertaking, but said they could only do so for the amount standing upon their general balance-sheet as at Dec. 31 last—£25,763—together with £1750 since expended. The Committee recommended the Council to offer the Company £75,000, which, in their opinion, was £4900 in excess of the present value of the shares; and that the Electric Lighting Company should be asked to state what sum they were prepared to accept. The Convener of the Committee said they considered that the price of £75,000 for the Gas Company was fair and reasonable; but that the claim of the Electric Lighting Company was beyond the range of discussion. The opposition to the proposal was stated in this way: If the Electricity Company had not paid, up till now, and if the Gas Company were not likely to pay in the future, or if its prospects were not certain, it would be injudicious to make an offer to either of them. The Council had nothing to lose by waiting on, but everything to gain. Would it not be much better to let the two Companies go on and fight it out between them? I do not know if this nebulous reasoning carried the day or not; but it was resolved not to go any further in the matter in the meantime, and the Committee were discharged. Before leaving this subject, I wish to point out that notwithstanding the point of view which was recommended, of the probable decadence of the Gas Company and the advance of the Electric Lighting Company, the Council did not believe in any such state of matters arising. They were prepared to offer the Gas Company £75,000 for a capital of £50,000; but with reference to the Electric Lighting Company, they even grudged the actual amount of their outlay. The reason, of course, is that the Gas Company is believed to have a future, while the other has not.

The Falkirk Town Council have been able to place their new issue of £10,000 for the gas-works extensions at £103 10s. per cent. The stock bears interest at the rate of 3 per cent; and it was subscribed more than three times over.

The Denny Police Commissioners this week accepted the offer of Mr. G. R. Hislop, of Paisley, to erect an oven of six retorts upon his regenerative system. There was an increase of 44,000 cubic feet of gas last month, as compared with the consumption in the corresponding period of last year.

There is at present every prospect that the Police Commissioners of Stirling will prosecute their intention to acquire the undertaking of the Stirling Gaslight Company, and there is pleasure in noting that, so far, they have sought to conduct the negotiations with the Company in an amicable spirit. On Monday of this week, a Committee reported that they had communicated with the Company, and had received a reply to the effect that, while the Directors did not see their way at this stage to agree either to the joint appointment of a man of skill to examine and report as to the value of the undertaking, they had themselves received expert advice. This showed that not only were the works and plant sufficient for present demands, but that, from the large area available, the position and levels of the site, and the proximity to the railway, they are well adapted to economical working and extension. The feeling of the Directors was that, as the shareholders had at present a good and sound investment for their capital, they would not be justified in recommending for their acceptance any proposal which would lower the annual return now being received, or prejudicially affect the capital value of the undertaking. They stated that, while they had no desire to part with their property, they did not wish to stand in the way of any general improvement by the municipality; and that if it was decided to acquire the undertaking, under the Act of 1876 or otherwise, they would be glad to meet with any Committee appointed by the Commissioners for further negotiations. It was moved that the Commissioners resolve to acquire the undertaking of the Company, and proceed to negotiate with the Directors. The Committee had had before them reports from seven burghs in which the gas undertakings had been taken over; and they were all favourable to the movement. Of course, they could not complete the negotiations without first consulting the ratepayers. One gentleman proposed that they delay consideration for a month; but no one supported him, and the recommendation of the Committee was adopted.

The Dunfermline Town Council have appointed their Town Clerk to perform the duties of clerk to the Commissioners who are engaged in the work of procuring the transfer of the undertaking of the Gas Company to the Corporation. The appointment was made quietly. In the Town Council, however, there was a wrangle over a proposal to give the Gas Committee plenary powers under the Burghs Gas Supply Act. Naturally the Councillors who were left out objected to being placed in a position in which, while responsible for the issue of the negotiations, they had no say in the matter. They were in a minority, however; and all that they could secure was that when anything important was done, it would be reported to them. But before the report is made, the business will be completed and beyond recall. I suppose the step has been taken in order to circumvent some tattlers among the Commissioners; the point being put, as against taking the whole Council into confidence, that supposing they were in negotiation with a witness, who might tell them that he could not give evidence on their behalf, they would be obliged to communicate the fact. Suppose they did, the interest of the Corporation might be prejudiced; but that is only a reason for further cutting down the Committee, as the stock complaint against giving the Committee full powers was that, while information was refused at the public board, it could most easily be got from the public, showing that there are at present tattlers on the Committee.

By their Unification Act, the Corporation of Dundee have done

away with the Gas Commission, which is now a department of the Corporation. One effect of this arrangement is that the annual excursion of the Gas Commissioners has been dropped; but while doing this, the Corporation have curiously imposed one-half of the cost of the annual inspection of the water-works upon the gas department, although the members of the Corporation will attend the inspection, not as administrators of the gas department, but of the water department.

The Perth Gas Commissioners seem to have given up the notion of ultimately removing their gas-works to the Sand Island, and to have agreed upon the Friarton Farm site, which was favoured by Mr. T. Whimster, the late Manager. This week a small Committee was appointed to visit the Friarton Farm and select a site. Mr. Wright, the Convener of the Works Committee, whose sympathies last year lay with the Sand Island site, said that, although he was appointed to the Committee, it was not to be assumed that he was in favour of removing the works. The fact is that the new Manager (Mr. A. Wilson) is prepared to go on with the works on the present site for some time; and so the question of removal is practically shelved. But, given a continuance of the present prosperous position of the Gas Commission, it can only be for a few years that the question of transfer to a new site can be deferred. The output of gas during the year which ended on April 30 amounted to 115,167,900 cubic feet, which was an increase on the quantity in the preceding year of 9,782,700 cubic feet, equal to 9·28 per cent.; and which, in turn, was 8,817,600 cubic feet more than in the previous year. The gas supplied was of the average illuminating power of 26·62 candles. The quantity of coal carbonized was 10,604 tons, as compared with 9346 tons; and the yield of gas per ton was 9703 cubic feet. During the past year, there was also used 609 tons of oil, as compared with 586 tons; and the yield of gas per ton of oil was 20,198 cubic feet. Of the gas made, 102,883,380 cubic feet was from coal, and 12,284,520 cubic feet from oil.

The Committee of the North British Association of Gas Managers met in Edinburgh this week to make arrangements for the meeting in that city in the end of July. I understand the prospects for the meeting are considered to be good.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May* 16.

Sulphate of Ammonia.—The quieter market noted in the last report has continued throughout the week; and values have declined a further 1s. 3d. per ton. Makers, with decreasing production, are fairly comfortable; and for the most part show no great anxiety to sell. On the other hand, direct orders are not very plentiful; the buying being mostly by dealers. Closing values are £7 18s. 9d. to £8 1s. 3d. per ton f.o.b. at the ports. Buyers are giving more attention to the forward position—June/August and October/March. But so far makers evince no great disposition to sell ahead—the premium obtainable on present low prices being only 5s. to 10s. per ton, according to position; and this is not considered sufficiently tempting. So that in the main the field is left to speculators.

Nitrate of Soda is unchanged; spot value being 7s. 10½d. to 8s. per cwt., according to quality.

LONDON, *May* 16.

Tar Products.—There is a "squeeze on" for 90's benzol. It looks very much as if some of the middle men had oversold themselves, expecting the market to collapse. Whether, therefore, the higher prices now being quoted will be maintained, it is difficult to forecast; but the stocks of benzols in makers' hands are undoubtedly low. A little better feeling pervades the carbolic acid market; and disinfecting liquid carbolic is moving off more freely, while carbolic crystals do not respond to the improvement in crude. Solvent naphtha remains about the same, with a tendency to harden; but there is comparatively a weak market for crude 30 per cent. Pitch continues easy; but creosote is distinctly better. Anthracene, however, is quoted lower on the report of the reduced prices for alizarine. Great disparity is being noted in the prices that are being paid for tar. This doubtless arises from the difference in the qualities; but more probably from the geographical position of the gas-works producing it.

Values obtaining during the week are: Tar, 17s. to 23s. 6d. Pitch, 30s. to 32s. 6d. Benzol, 90's, 2s. 2d.; 50's, 1s. 10½d. Toluol, 1s. 5d. Solvent naphtha, 1s. 2d. Crude, 30 per ct., naphtha, 8d. Creosote, 1½d. Salts, pressed, 55s.; drained, 30s. Cresylic acid, 1s. Carbolic acid, 60's, 2s. 1½d. Anthracene "A," nominal, 11d.; "B," 8d. to 9d.

Sulphate of Ammonia is in moderate request at £8, less 3½ per cent. at all ports, with an easier tendency in the north-east ports. For forward delivery, makers are asking somewhat higher prices; but there is no forward business of any importance being done. The continued disparity in the nitrogen value of sulphate of ammonia and nitrate is the most surprising feature in this market. Gas liquor is offered at 5s. 6d. to 7s.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The position in this district gradually gets worse as the summer advances, at least so far as round coals are concerned; a decided slackening off in the demand being reported generally, with stocks increasing at the local collieries, except where they have gone on to short time. Although quoted rates for house coals are nominally unchanged, there is a disposition to give way upon list rates where orders for anything like quantities can be secured; while coal is coming in from other districts—especially Yorkshire—at prices, in some cases, 1s. to 1s. 6d. per ton under the quotations of local collieries for similar qualities. Steam and forge coal continues in but

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 1110).

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	15 Apl.	10½	Alliance & Dublin 10 p. c.	24½–25½	..	4 2 4
100,000	10	,,	7½	Do. 7 p. c.	17–18	..	4 3 4
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	110–112	..	4 9 3
200,000	10	16 Oct.	4	Belgrano (B. Ayres), Limited	8½–9½	..	4 4 3
100,000	Stck.	30 Dec.	5	Do. 5 p. c. Deb. Stk	95–100	..	5 0 0
200,000	5	14 Nov.	6½	Bombay, Limited	7½–8	..	4 1 3
40,000	5	,,	6½	Do. New, £4 paid	5½–6	..	4 6 8
380,000	Stck.	27 Feb.	12	Brentford Consolidated	280–285	..	4 4 3
210,000	,,	,,	9	Do. New	217–222	..	4 1 0
50,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
159,375	,,	16 Dec.	4	Do. 4 p. c. Deb. Stock.	129–134	+2	2 19 9
220,000	Stck.	27 Mar.	11	Brighton & Hove Original	237–242	+5	4 10 11
208,820	,,	,,	8	Do. A Ord. Stk.	190–195	+3	4 2 0
933,500	Stck.	27 Feb.	5	Bristol, 5 p.c. max.	127–132	..	3 15 9
420,000	20	27 Mar.	11½	British	56–57	+½	3 18 11
50,000	10	12 Mar.	11½	Bromley, Ordinary 10 p. c.	22½–23½	..	4 17 10
71,000	10	,,	8½	Do. 7 p. c.	19–20	..	4 5 0
500,000	10	29 Apl.	5	Buenos Ayres (New) Limited	9–9½	..	5 5 3
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	102–104	..	5 15 5
150,000	20	27 Feb.	8½	Cagliari, Limited	29–31	..	5 6 5
100,000	10	27 Sept.	8†	Cape Town & District, Ltd.	16½–17½	+½	4 11 4
50,000	50	2 May	6	Do. 6 p. c. 1st Mort.	58–60	..	5 0 0
550,000	Stck.	15 Apl.	13½	Commercial Old Stock	338–343	+1	3 18 8
165,000	,,	,,	10½	Do. New do.	255–260	..	4 0 9
165,000	,,	16 Dec.	4½	Do. 4½ p. c. Deb. do.	147–152	..	2 19 2
800,000	Stck.	16 Dec.	13	Continental Union, Limited.	285–290	..	4 9 8
200,000	,,	,,	10	Do. 7 p. c. Pref.	217–222	..	4 10 1
51,600	Stck.	27 Feb.	14	Croydon Com'cial A 10 p. c.	—	..	—
157,500	,,	,,	11	Do. B 7 p. c.	—	..	—
535,000	Stck.	27 Feb.	5½	Crystal Palace Ord. 5 p. c. Stk	130–135	..	3 17 9
60,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
486,090	10	30 Jan.	11	European, Limited	26–27	..	4 1 6
354,060	10	,,	11	Do. £7 10s. paid	17½–18½	..	4 9 3
5,746,590	Stck.	13 Feb.	12¾	Gaslight & Coke, A, Ordinary	308–313	+5½	4 1 5
100,000	,,	,,	4	Do. B, 4 p. c. max.	108–113	..	3 10 9
665,000	,,	,,	10	Do. C, D, & E, 10 p. c. Pf.	297–302	+2	3 6 8
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	145–150	..	3 6 8
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	210–215	..	3 9 0
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	205–210	+1	3 6 8
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	295–300	+5	3 6 8
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	172–177	+4½	3 7 10
1,061,150	,,	16 Dec.	4	Do. 4 p. c. Deb. Stk.	140–143	..	2 15 11
294,850	,,	,,	4½	Do. 4½ p. c. do.	150–155	..	2 18 0
908,000	,,	,,	6	Do. 6 p. c. do.	204–209	..	2 17 5
70,000	10	14 May	6	Hongkong & China, Limited	12½–13½*	..	4 8 10
3,800,000	Stck.	14 May	12	Imperial Continental	250–255*	..	4 14 1
376,400	100	1 Feb.	4	Do. 4 p. c. Debs. Red.	100–103	..	3 17 8
473,600	Stck.	13 Feb.	3½	Do. 3½ p. c. Deb. Stk	108–110	..	3 3 8
75,000	5	16 Dec.	6	Malta & Mediterranean, Ltd.	6½–7	..	4 5 8
560,000	100	1 Apl.	5	Met. of Melbourne, 5 p. c. Deb.	115–118	..	4 4 10
250,000	100	,,	4½	Do. 4½ p. c. Debs.	110–112	..	4 0 4
541,920	20	14 Nov.	5	Monte Video, Limited	17–18	..	5 11 1
150,000	5	28 Nov.	8	Oriental, Limited	8½–8¾	..	4 11 5
135,000	5	,,	8	Do. New, £4 10s. paid	7½–7¾	..	4 12 10
15,000	5	,,	8	Do. do. 1879, £1 paid	1½–2	..	4 0 0
60,000	5	12 Mar.	7	Ottoman, Limited	5–5½	..	6 7 3
166,870	10	—	2	Para, Limited	1½–1¾	..	—
420,000	100	2 Nov.	6	People's Gas } 1st Mtg. Bds.	105–110	..	5 9 1
500,000	100	9 Dec.	6	of Chicago } 2nd Do.	105–110	..	5 9 1
250,000	10	27 Mar.	8	San Paulo, Limited	13½–14½	..	5 10 4
500,000	Stck.	13 Feb.	15½	South Metropolitan, A Stock	400–410	..	3 15 7
1,350,000	,,	,,	12	Do. B do.	315–320	..	3 15 0
310,000	,,	,,	13	Do. C do.	335–340	+2½	3 16 6
800,000	,,	16 Jan.	5	Do. 5 p. c. Deb. Stk.	175–178	..	2 16 2
60,000	Stck.	12 Mar.	11½	Tottenham & Edmonton, A	250–255	..	4 10 2
60,000	,,	,,	8½	Do. B	—	..	—
170,380	10	30 Dec.	10	Tuscan, Limited	13¾–14½	..	6 18 0
149,900	10	2 Jan.	5	Do. 5 p. c. Debs. Red.	100–102	..	4 18 0
				WATER COMPANIES.			
746,021	Stck.	30 Dec.	10½	Chelsea, Ordinary	337–342	+7	2 19 10
150,000	,,	,,	5	Do. 5 p. c. Pref.	170–175	..	2 17 1
160,000	,,	,,	4½	Do. 4½ p. c. Pref. Stk., 1875	—	..	—
175,785	,,	27 Mar.	4½	Do. 4½ p. c. Deb. Stock	157–162	..	2 15 6
1,719,514	Stck.	15 Apl.	7	East London, Ordinary	245–250	..	2 16 0
654,740	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	157–162	..	2 15 6
100,000	,,	,,	3	Do. 3 p. c. Deb. Stk.	105–107	..	2 16 1
700,000	50	16 Dec.	6½	Grand Junction, 10 p.c. max.	124–128	..	2 10 8
280,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	148–152	..	2 12 8
708,000	Stck.	13 Feb.	12	Kent	338–343	..	3 10 0
160,000	,,	,,	7	Do. New, 7 p. c. max.	210–215	+3	3 5 1
1,043,800	100	30 Dec.	7½	Lambeth, 10 p. c. max.	275–280	..	2 11 8
406,200	100	,,	7½	Do. 7½ p. c. max.	227–232	..	3 2 6
330,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	147–152	..	2 12 8
500,000	100	13 Feb.	12¾	New River, New Shares	430–435	+1	2 18 7
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	154–159	+1	2 10 4
902,300	Stck.	16 Dec.	6	S'thwk & V'xhall, Ordinary	167–172	..	3 9 9
126,500	100	,,	6	Do. Do. 7½ p. c. Max.	155–165	..	3 12 9
489,200	Stck.	,,	5	Do. Do. 5 p. c. Pref.	168–173	..	2 17 9
1,019,585	,,	15 Apl.	4	Do. 4 p. c. A Deb. Stk.	147–152	..	2 12 8
1,155,066	Stck.	16 Dec.	10	West Middlesex	325–330	+5	3 0 7
200,000	,,	,,	4½	Do. 4½ p. c. Deb. Stk.	157–162	..	2 15 6

*Ex div.

† Next dividend will be at this rate.

slow demand. Supplies are excessive, with prices as low as ever; 6d. to 9d. per ton under the average market prices being taken on quantities for prompt clearance. At the pit mouth, best Wigan Arley averages 9s. 6d. to 10s. per ton; Pemberton four-feet and seconds Arley, 8s. to 8s. 6d.; common house coal, 6s. 6d. to 7s.; and steam and forge coals, 6s. As regards gas coals, some small contracts have recently been placed; and it is reported that upon these something like last year's prices have been got—6s. 7d. per ton at the pit being mentioned as the figure obtained for good screened Wigan Arley. But the reduction in locomotive fuel prices, to which I have previously referred, is naturally encouraging representatives of gas companies to press for some similar concession upon last year's contract prices for gas coal. Of course, it remains to be seen whether they will be successful to any appreciable extent. In engine classes of fuel, supplies at the local collieries are getting rather scarce, owing to the diminished demand for round coals, and prices show a hardening tendency; but slack is coming in rather more freely from other districts, so that any really general advance is scarcely feasible. At the pit, best slack remains at 4s. 6d. up to 5s. per ton; good medium sorts, 3s. 6d. to 4s.; and common qualities, 3s. to 3s. 3d. For shipment, though there is a fair demand, business can only be secured at extremely low prices; common steam coal not fetching above 6s. 9d. to 7s. 3d. per ton, delivered at Mersey ports or the Partington tips of the Ship Canal.

Northern Coal Trade.—After a lull, there is renewed activity in the steam coal trade of this district, as is frequently the case before holidays, shippers desiring to get supplies forward. Best steam coal is again steady at 8s. 3d. per ton f.o.b. for prompt supplies, though there have been one or two sales recently slightly below this rate, to ensure full work for the collieries in the dull time. As the shipments are now going well forward, and the holidays will limit the supplies, it is probable that there will be full work at most of the pits for a week or two ahead. Steam smalls are fairly steady at about 3s. 9d. per ton, and have been rather scarce. For shipment, 10s. to 10s. 9d. per ton f.o.b. is the current quotation. In regard to manufacturing coals, the demand is fairly good; and as the deliveries are on long contracts, the prices do not vary. Gas coals are quiet; the local demand being very limited, while the increase in the shipments is mainly confined to two or three collieries that are near navigable waters. There is no alteration in the quotations; the latter varying, according to the position of the colliery, from 6s. 3d. per ton f.o.b. up to about 6s. 9d. One leading Durham coalowner is, however, able to ask 7s. 3d. per ton for odd cargoes; his order books being fairly full. The coke trade is steady; the consumption locally being very large, and the price well supported at about 13s. 9d. per ton at the Durham and Teesside blast-furnaces. The exports of coke are still rather light, though a little more promising; and the price still remains at 15s. per ton f.o.b. There is no alteration in the condition of the gas coke trade, or in the price; but stocks are low.

Scotch Coal Trade.—The same state of matters exists—a very large output, but no improvement in prices. In fact, if there is any movement in rates, it is rather downward than upward. The great bulk of the business is on short contract; gas-works supplies being, perhaps, a general exception to this rule. The prices quoted continue to be: Main, 5s. 9d. (easy) per ton f.o.b. Glasgow; ell, 6s. 3d. to 6s. 9d.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. The shipments for the week amounted to 182,105 tons—a decrease of 7509 tons as compared with the preceding week, but an increase over last year of 20,739 tons. For the year to date, the total shipments have been 2,404,302 tons—an increase on the corresponding period of last year of 198,520 tons.

East Dereham Gas Supply.—It was reported at the last meeting of the East Dereham District Council that the receipts for the past year from the gas-works amounted to £2489, and that there was a clear profit of £642. The Gas Committee are considering the question of reducing the price of gas.

Messrs. S. Cutler and Sons' Recent Contracts.—The Corporation of Doncaster have accepted the tender of Messrs. S. Cutler and Sons, of Millwall, for a new three-lift gasholder of 600,000 cubic feet capacity, with wrought-iron guide-framing. Under the advice of Mr. George Livesey, the Newark Gas Company are considerably increasing their storage; and they have entrusted the construction of a new gasholder to the firm. The Directors of the Crays (Kent) Gas Company have placed in their hands the construction of a new tank and gasholder. The former is to be 80 feet in diameter and 26 feet deep, and made of rolled steel plates; and the holder will be a two-lift one, with wrought-iron spiral guide-framing on Cutler's patent system. The designs have been prepared by the Company's Consulting Engineer (Mr. A. F. Phillips, M.Inst.C.E.), under whose superintendence the work is to be carried out.

The London County Council and the South Metropolitan Gas Bill.—At the meeting of the London County Council last Tuesday, the Parliamentary Committee reported that the time for petitioning against the South Metropolitan Gas Bill expired in the House of Lords on the 12th inst. They had reported fully the facts connected with the matter to the Council on the 5th inst.; and, at the conclusion of their report, they stated that they would consider whether the Bill, as altered by the Committee of the House of Commons, should be accepted, or whether the clauses as to stock-splitting should be opposed in the House of Lords. Having regard to all the circumstances of the case, they had not thought it necessary to instruct their Parliamentary Agent to proceed any further, and they recommended that their action with regard to the Bill be approved. Mr. Pearce proposed that the clauses should be opposed. Mr. Leon seconded the proposition, but, as it only received three votes, it was lost, and the recommendation of the Committee was agreed to.

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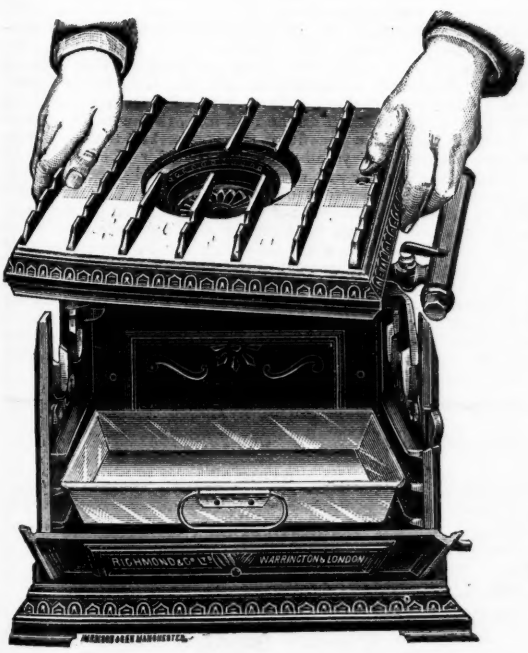

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206	13½ „ 12½ „ 10	10¾ „ 10¼ „ 7½	25s. 0d.

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Burslem Corporation Gas Department.—The minutes submitted by the Gas Committee at the meeting of the Burslem District Council yesterday week included a statement showing that there was a balance of profit of £1028 on the past year's working of the undertaking. It was agreed that £1000 should be appropriated in reduction of the general district rate.

The Maidstone Gas Company's Provisional Order.—The Board of Trade have formally announced their sanction to the Provisional Order applied for by the Maidstone Gas Company. The Order is for the creation of debenture stocks; the undertakers to pay off as soon as may be after the date of the Order the sum of £7300 now due and owing by them on mortgages created under the provisions of their Act of 1880, and so cancel the powers under that Act. The debenture shares issued under the Order are to be submitted to public auction or tender before being offered to any holder of ordinary shares or stock in the Company.

The Working of the Heywood Corporation Gas Department.—At the quarterly meeting of the Heywood Town Council last Thursday, Mr. A. C. Maden, the Chairman of the Gas Committee, made a statement regarding the working of the department during the year ended March 31 last. He said the total receipts on revenue account amounted to £18,575; and the expenditure, to £12,450—leaving a gross profit of £6124. After allowing the sum of £4802 for sinking fund and interest, there was a net profit of £1322. The favourable result of the year's working was principally due to the increased consumption of gas, and the reduction of the leakage account, which was practically 2 per cent. less than in the previous year.

Arrol-Foulis Retort-House Machinery.—The Metropolitan Gas Company of Melbourne are about to introduce hydraulic stoking machinery into their works, and they have just placed an order with Sir William Arrol and Co., Limited, for a complete plant, including elevators and coal-breakers. As mentioned last week, the Leeds Corporation Gas Committee have decided to adopt stoking machinery at their new Wortley works; and they have ordered from the above-named firm drawing and charging machines, elevators, coal-breakers, and pumping-engines. The Arrol-Foulis machines having now been at work for some time at the Linacre works of the Liverpool Gas Company, it is satisfactory to note that the Company have requested the makers to supply additional plant of the same character.

The London County Council and the Sea Water Supply Bill.—At the meeting of the London County Council last Tuesday, the Joint Parliamentary and Water Committee reported that, in accordance with their instructions, the Parliamentary Agent had been negotiating with the promoters of the London Sea Water Supply Bill for the insertion of various clauses for the protection of the Council and the Local Authorities, and, among them, for a clause providing that the Bill should not confer upon the promoters the exclusive privilege of supplying sea water in London. The promoters gave a written undertaking that they would insert such a clause in their Bill, on the faith of which the Agent withdrew the Council's petition; but they had omitted to carry out their undertaking. The Committee accordingly instructed the Agent to take the necessary steps for remedying the omission. They thought that, if necessary, the House of Commons should be asked to recommit the Bill, in order that effect might be given to the undertaking. The report was adopted.

The Hull Water Committee and their Engineer.—The "Hull Daily News" announces that a statement was current in the town early last week that the question of the position of Mr. B. J. E. Bruce, the Corporation Water Engineer, is to be brought into a Court of Law. Our contemporary adds: "Mr. Bruce is the third Engineer of the water-works who has been practically sent about his business in a period of about thirty years. The vote by which the report of the Water-Works Committee was adopted [see *ante*, p. 1052] was not dictated by personal motives, for many who voted for the adoption of the report did so from a strong sense of public duty; and there were among the majority many who have a high personal regard for Mr. Bruce, but who still felt compelled to uphold the majority report of the Committee, who had spent many months in trying to get at the bottom of a condition of things in connection with the water-works that could not be considered by any means satisfactory. . . . The position of Mr. Bruce must be admitted to be a serious one for himself. He held a very good appointment; and there is no doubt that for many years he was trusted fully by the Corporation. For some time past now, there has been considerable friction between himself and the Water-Works Committee; and the difficulty has culminated in a determination on the part of the Committee and the Council to appoint a successor to Mr. Bruce, at a slightly increased salary." The contemplated action by Mr. Bruce is for injury to professional reputation; the damages, it is rumoured, being laid at £20,000.

Wigan Coal and Iron Company, Limited.—The Midland Counties and West of England Coal Agency (Mr. A. C. Scrivener) have removed their offices from No. 22, Temple Street, to Prince's Chambers, No. 6, Corporation Street, Birmingham.

Incandescent Gas-Lighting at Leamington.—Mr. W. de Normanville, the Borough Engineer of Leamington, reports that three months' experience of the incandescent gas-burner for street lighting shows that the system is unsatisfactory, in consequence of the breaking of so many mantles through the vibration caused by vehicular traffic. In three months 90 mantles were used for fifteen burners, while 54 chimneys had been fractured. The Town Council have decided to discontinue the use of the burners.

The Oil-Tanks for the Manchester Gas-Works.—The Manchester Corporation have decided to place their contract for oil-tanks for storing oil in connection with the new carburetted water-gas plant with West's Gas Improvement Company, Limited. There are three tanks in all, two of which are to be erected at Mode Wheel, on the banks of the Ship Canal. These are each 60 feet in diameter, and 30 feet high; and they will receive the oil direct from ships which convey it up the canal. The third is to be placed at the Bradford Road Gas-Works, in close proximity to the water-gas plant. It is 50 feet in diameter and 25 feet high. The oil will be conveyed by means of barges from the two tanks at Mode Wheel up the Bridgewater Canal to the canal siding in the gas-works, and pumped from the barges up to this tank.

Essex and the Water Board Bill.—A special meeting of the Ilford District Council was held last Wednesday, in regard to the Metropolitan Counties Water Board Bill. The Chairman (Mr. E. J. Beal) said the Bill allowed two representatives from Essex, but made no provision as to their coming from the district affected by clause 5 of the Bill. The residents of Ilford and Chadwell at present supplied by the South Essex Water Company would have to pay another rate in addition to that of the Company, for the purpose of supplying water to London and to that portion of Ilford served by the East London Water Company. Mr. A. Money-Wigram, M.P., said the Bill would probably be passed by the House of Lords; but it was improbable that it would be down in the House of Commons this year. He said he would see Lord James about clause 5, and endeavour to get it altered, or induce his Lordship to receive a deputation on the subject. This proposal was agreed to.

Injury to a Railway by the Bursting of a Water-Main.—On the night of Saturday, the 9th inst., a water-main, forming part of the system which conveys water from Whittle Dene to Newcastle, burst at Newburn. The pipes which fractured are situated on an eminence at the west of the Walbottle Coal Company's colliery, overlooking the North Wylam branch of the North-Eastern Railway and the main road leading from Newburn to Lemington. When the mishap occurred, the water flowed violently over the bank and along by the side of the line. Eventually the ashes and ballast on which the metals were laid gave way, and the water rushed underneath the rails, and left the sleepers and metals suspended. Shortly before the accident happened, a passenger train had passed over the spot; and at the time of the occurrence a train was leaving Lemington Station to proceed to North Wylam. Fortunately, however, a message was conveyed to the station officials, and the train was stopped; otherwise a serious disaster might have resulted. The water flooded the main road, and eventually found its way into the Tyne.

The Newtownards Town Commissioners and their Gas Manager.—There is no accounting for the ways of some Irishmen. The Newtownards Town Commissioners are the owners of the gas-works, which have been managed, as the Commissioners acknowledge, satisfactorily by Mr. J. Dewar. The concern is not large, nor is the Manager's salary; but at the close of the past financial year there was a balance of £100, with as much coal as would last another quarter. The Gas Committee are fired with a spirit of economy; and at the meeting of the Commissioners on the 10th inst., they actually reported that "it would be for the benefit of the gas-works" that Mr. Dewar should leave; and that they had given him the offer of sending in his resignation. This Mr. Dewar declined to do; and accordingly the Committee asked for power to give him a month's notice. One member of that body was highly eulogistic of the Manager; and he went so far as to say he would "rather have thrown a £5 note into the fire than intimate to him the decision of the Committee, as he was appointed to do." As to the future management of the works, nothing definite was said. The Committee must deal with it, if the Commissioners have confidence in them. It has been suggested by a local paper that the members of the Committee will take charge of the works by turns. If so, we shall be curious to see the result. We do not believe in amateur management; and we fear that the fancied economy will in the end prove to be a loss to the ratepayers.

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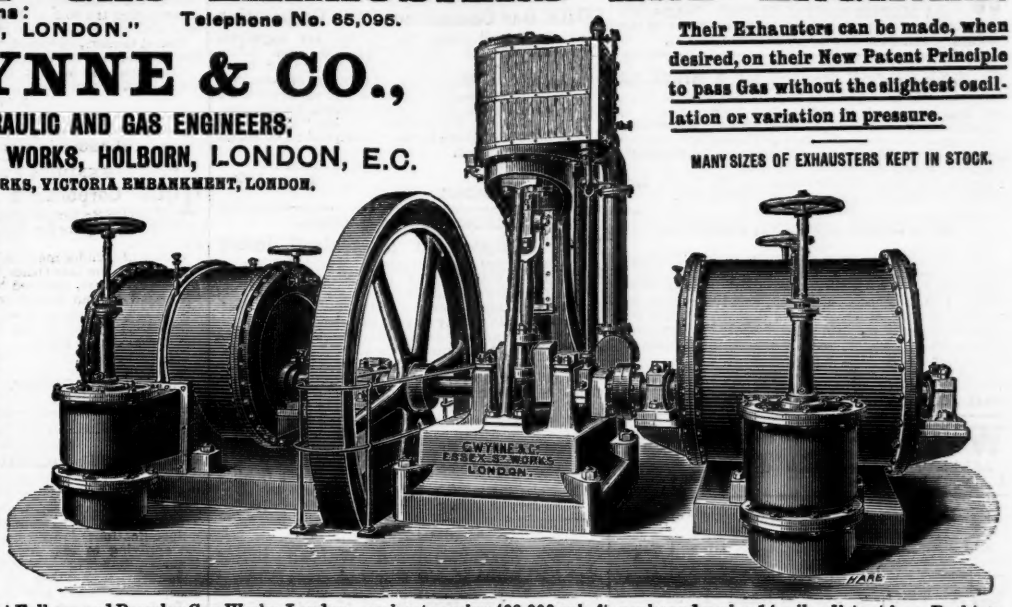

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SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
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NEW GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO., VICTORIA PAINT WORKS, MANCHESTER.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

It is Worth Your While to Buy DIRECT.
THE RELIANCE LUBRICATING OIL COMPANY SUPPLY on APPROVAL "RELIANCE" NON-CORROSIVE LUBRICANTS (which, through their superiority, have the largest sale in the world)—viz., Engine, Cylinder, and Machinery Oils, 11½d.; Spindle Oil, 8½d.; Gas-Engine and Dynamo Oils, 1s. 6d. per gallon; Barrels Free and Carriage Paid. Also Liquids for Gas Making, Enriching, &c.
RELIANCE LUBRICATING OIL COMPANY, WATER LANE, GREAT TOWER, LONDON, E.C.
Depôts at Liverpool, Bristol, Hull, Glasgow, and Newcastle-on-Tyne. Telegrams: "Subastral, London."

TO GAS COMPANIES MAKING SULPHATE OF AMMONIA.

THE Use and Value of Sulphate of Ammonia as Manure—A Leaflet, suitable for Distribution among the Farmers of their respective Districts, by WILLIAM ARNOLD, F.S.I., Land Agent, Rating Surveyor, and Valuer (late Chairman of the Tamworth Gaslight and Coke Company); together with valuable Formulæ, Rotation of Crops and Manures for the same, intended for the use of Tenant Farmers and others interested in Land, and to promote the sale of Sulphate of Ammonia for the production of Corn and other Crops by English Gas Companies.
Prices: 100 Copies, 10s.; 250 Copies, £1 2s. 6d.; 500 Copies, £2; 1000 Copies, £3 15s.
LONDON: WALTER KING, 11, Bolt Court, FLEET STREET.

SITUATION wanted as Leading Fitter. Well up in Stoves, Meters, Services, &c. Would take charge of Men, and control of Automatic Supplies, or Labour connected with same. First-class references. Total Abstainer.
"FITTER," 445, BATTERSEA PARK ROAD, S.W.

WANTED, a Gas-Fitter, experienced in Service Laying, Meter and Stove Fixing, House Fitting, and usual routine of Gas-Works. Wages 32s. per week.
Apply, stating Age, with *Copies* of two Testimonials, to the MANAGER, Gas-Works, Barry, GLAMORGANSHIRE.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, } SCOTLAND.
NEWTON GRANGE, NEWBATTLE, DALKEITH, }

TO EMPLOYERS, COMPANY DIRECTORS, ETC.

THE LAW GUARANTEE & TRUST SOCIETY, LD.
GUARANTEES FIDELITY.

SEND for complete Prospectus containing Balance-Sheet, Copy of Policy, &c., &c. Mortgage, Debenture, License, and Contingency Insurance.
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HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

THE Directors of the New Incandescent (Sunlight Patent) Gas Lighting Company, Limited, are prepared to receive APPLICATIONS for the post of BUSINESS MANAGER.
Apply, with full statement of Qualificatcns and Salary, to the SECRETARY, 40, Coleman Street, LONDON, E.C.

LONGTON CORPORATION GAS-WORKS.

THE Gas Committee are prepared to receive APPLICATIONS for the appointment of MANAGER and SECRETARY of their Gas-Works. He will be held responsible for the whole management of the Undertaking, but will be provided with the necessary assistance to relieve him of the Clerical Duties.
Salary, £300 per Annum.
The person appointed will be required to devote the whole of his time to the discharge of the duties of his office, and to provide a guarantee, in an approved Guarantee Society, in the sum of £500 for faithful service.
Canvassing strictly prohibited.
Applications (endorsed "Manager"), stating Age and previous Employment, accompanied by *copies* of not more than three recent Testimonials, to be addressed to the Chairman of the Gas Committee, and to be delivered not later than Twelve a.m. on Wednesday the 27th inst.

W. W. HULSE,
Secretary and Manager.
Gas-Works, Longton, Staffs.,
May 11, 1896.

RUSHDEN AND HIGHAM FERRERS DISTRICT GAS COMPANY, LIMITED.

WANTED, an experienced Ledger and METER RENTAL CLERK. Wages 30s. Applications, with Testimonials, to be made to the Secretary, Mr. GEO. S. MASON, RUSHDEN, R.S.O.

BOOKKEEPER wanted for a Brazilian Gas-Works. A young Man, single, age about 25, who has been accustomed to Gas Accounts, and is willing to make himself generally useful. Knowledge of Portuguese a great advantage. Immediate employment for a suitable person. *Copies* of two Testimonials required, which will not be returned.

Apply, by letter, stating terms, to B. P. G., care of Messrs. Deacon's, LEADENHALL STREET, E.C.

BUTE DOCKS COMPANY, CARDIFF.

GAS-WORKS ENGINE DRIVER AND STOKER.

WANTED, a competent and steady Man to take charge of Engine and Exhauster, and superintend the Stoking Work, &c. Wages, 36s. per week of Seven days. None need apply who have not filled a similar position, and one used to the "Donkin" Exhauster and Regulator preferred.

Send copies of Testimonials, State Age, and apply in own Handwriting, to S. WARD, Manager, Bute Gas-Works, CARDIFF.

WANTED, a Second-Hand Purifier, about 16 feet square.

Address the YEADON GAS-RETORT COMPANY, Limited, 4, Albion Place, LEEDS.

WANTED, a second-hand Bar Photo-METER, complete, for small Works.

Address No. 2664, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a second-hand Hydraulic MAIN, with H-PIPES, MOUTHPIECES, LIDS, &c., complete, for a Bed of Sevens, 15-inch or 18-inch Round Retorts.

Price and full Particulars to

T. G. BROWNING,
Manager.

Gas-Works, Whitstable.

GASHOLDER FOR SALE.

INQUIRIES and Offers are invited for a second-hand GASHOLDER, in good condition, 40 ft. diameter by 12 ft. deep, including Columns, Girders, &c.

Address the MANAGER, Gas-Works, Sandown, ISLE OF WIGHT.

FOR SALE—One second-hand Station METER, in good order and condition; will pass 4000 Cubic Feet per hour. Also one second-hand EXHAUSTER and CONNECTIONS; will pass 3500 Cubic Feet per hour.

Apply to W. T. LAWRENCE, Clerk to the Council, MILLOM.

May, 1896.

GAS PLANT FOR SALE.

FOUR Purifiers, 10 feet square by 4 feet deep, complete with 10-inch Centre-Valve and Connecting-Pipes and Lifting Apparatus (replaced by larger Purifiers); Cutler's patent CONDENSER, with 6-inch Connections and Four-Way Valve; GAS REFEREES' CUBIC FOOT MEASURE.

All the above in good working order.

For further Particulars apply to G. W. LUPTON, Gas-Works, Otley, near LEEDS.

HAMILTON CORPORATION GAS.

FOR SALE—Four Purifiers, 15 feet square by 5 feet deep, complete, with Hydraulic Centre-Valve, 12-inch Connections, and Hydraulic Lifting Apparatus; also a round STATION METER, with 12-inch Connections, passing 23,000 cubic feet per hour.

The above are in first-class working order.

Further Particulars may be had from the undersigned.

WM. EWING,
Engineer and Manager.

Gas Office, Hamilton,
May 14, 1896.

CORPORATION OF BLACKPOOL.

THE Gas Committee are prepared to receive TENDERS for the supply of COAL during the next Twelve Months.

Forms of Tender may be had from the undersigned, and must be sent in, addressed to the Chairman, and endorsed outside "Tender for Coal," by Saturday, May 23.

(Signed) JOHN CHEW,
Gas Engineer.

Gas Office, Blackpool,
May 8, 1896.

BARRY URBAN DISTRICT COUNCIL.

THE Committee of the Gas and Water Department are prepared to receive TENDERS for the supply and delivery of about 4500 Tons of GAS COAL, and 500 Tons of CANNEL, between July 1, 1896, and June 30, 1897, in such quantities and at such times as the Manager (of whom any further Particulars may be obtained) may require.

The Committee do not bind themselves to accept the lowest or any tender.

Sealed tenders, endorsed "Tender for Coal" or "Cannel," giving the names of the Pits from which the Coal will be raised, and the price per ton of 20 cwt., delivered into their Siding at the Gas-Works, Barry, to be addressed to the Chairman of the Gas and Water Committee, Barry Urban District Council, Barry, Glamorganshire, on or before Saturday, June 13.

Gas and Water Offices, Barry,
May 12, 1896.

BOROUGH OF WALSALL.
(GAS DEPARTMENT.)

RETORT MOUTHPIECES AND LIDS.

THE Gas Committee of the Corporation of Walsall invite TENDERS for supplying 160 GAS-RETORT MOUTHPIECES and LIDS (oval ⌂), 20 in. by 16 in. The Lids to be fitted complete with the latest Improvements in Self-Sealing. Template of Mouthpieces can be had on application to Mr. John Tindall, Gas Engineer, Pleck Gas-Works.

Tenders, sealed, and marked outside "Tender for Retort-Lids," to be sent to the undersigned on or before Monday, June 1 next.

JOHN R. COOPER,
Town Clerk.

Walsall, May 13, 1896.

TENDERS FOR GAS COAL.

THE Corporation of Walsall invite TENDERS for the supply of 40,000 Tons of STAVELEY, YORKSHIRE, or any other good GAS COAL, to be delivered during One Year from the 1st of July next, at the Corporation Siding at the Pleck Gas-Works, Walsall, as may be required.

Forms of Tender and Specification may be obtained on application to the undersigned.

The Corporation do not bind themselves to accept any tender; and they reserve the right to divide the Contract between several firms.

Tenders, sealed and marked outside "Tender for Gas Coal," and stating the price for large Coal and also for Nuts, are to be sent to the undersigned on or before Saturday, the 30th of May inst.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 15, 1896.

TO LIME MASTERS.

THE Corporation of Walsall invite TENDERS for the supply of about 800 Tons of LIME, which will be required at their Gas-Works during One Year from the 1st of July next; the deliveries to be in such monthly quantities as the Manager of the Gas-Works may from time to time direct.

The Lime is to be hand-picked, and clear from Refuse and Ashes, and to be delivered at Walsall Railway Stations as required.

Payments monthly.

Tenders, sealed and marked outside "Tender for Lime," are to be sent to the undersigned on or before Saturday, the 30th of May inst.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 15, 1896.

BOROUGH OF CONGLETON.

THE Gas Committee invite Tenders for the supply of 3500 Tons of screened GAS COAL, NUTS, BEANS, &c., and 500 Tons of screened CANNEL, CANNEL NUTS, &c.; to be delivered between the 1st of July, 1896, and the 30th of June, 1897.

Further Particulars may be obtained from the undersigned.

Sealed tenders, endorsed "Tender for Coal," addressed to the Chairman of the Gas Committee, to be delivered at the Town Clerk's Office, not later than Wednesday, May 27.

WM. ORME,
Manager.

TAR AND LIQUOR.

THE Gas Committee of the Borough of Congleton are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR, to be produced at their Gas-Works from July 1, 1896, to June 30, 1897.

Further Particulars may be obtained from the undersigned.

Sealed tenders, endorsed "Tar and Liquor," addressed to the Chairman of the Gas Committee, to be delivered at the Town Clerk's Office not later than Wednesday, May 27.

WM. ORME,
Manager.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Corporation of Birkenhead are prepared to receive TENDERS for the supply of COAL, COAL NUTS, THROUGH and THROUGH, CANNEL, and CANNEL NUTS for Gas-Making Purposes for a period of One, Two, or Three Years, commencing from the 26th of June, 1896.

Forms of Tender, together with any further Information, may be obtained from Mr. T. O. Paterson, C.E., Gas Engineer, Gas-Works, Birkenhead.

Tenders (accompanied by copy of Analysis), stating the Price per ton, delivered on to the Gas-Works Railway Siding, must be sent in to me, sealed and endorsed "Tender for Gas-Works Coal," not later than Five o'clock in the afternoon of Friday, the 29th of May, 1896.

Also for a supply of STEAM COAL and SLACK, to be delivered at the Pumping-Stations of the Spring Hill, Flaybrick Hill, and Borough Road Water-Works for a period of One, Two, or Three Years, commencing from the 26th of June, 1896.

Forms of Tender, together with any further Information, may be obtained from Mr. W. A. Richardson, C.E., Water Engineer, Town Hall, Birkenhead.

Tenders, stating the Price per ton delivered at the various Pumping-Stations, must be sent in to me, sealed and endorsed "Tender for Water-Works Coal," not later than Five o'clock in the afternoon of Friday, the 29th of May, 1896.

All Deliveries to be made from time to time according to the requirements of the respective Engineers.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
ALFRED GILL,
Town Clerk.

Town Hall, Birkenhead,
May 11, 1896.

TENDERS FOR TAR.

THE Aberdare, &c., Gas Company invite TENDERS for the purchase of the surplus TAR (about 220 Tons) produced at their Works for the Year ending the 30th of June, 1897. The Purchaser to send Railway Tanks when required for loading.

Sealed tenders, endorsed "Tar," to be addressed to the undersigned not later than the 2nd of June next.

The Company do not bind themselves to accept the highest or any tender.

EVAN JONES,
Secretary and Manager.

GLASGOW CORPORATION GAS.

TENDERS FOR METERS.

THE Corporation of Glasgow invite TENDERS for the supply of such DRY METERS as they may require for Twelve Months from the 1st of July next.

Forms of Tender may be had on application to the Manager at the Gas Office, 45, John Street, Glasgow; and sealed Offers, marked "Tender for Meters," to be addressed to, and lodged with, the Subscriber on or before Tuesday, the 26th current.

The Corporation do not bind themselves to accept the lowest or any offer.

J. D. MARWICK,
Town Clerk.

City Chambers, Glasgow,
May 6, 1896.

SOWERBY BRIDGE URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee of the above Council are prepared to receive TENDERS for the supply of 11,000 Tons of best GAS COAL and 1000 Tons of CANNEL required in each year for One, Two, or Three Years from June 1, 1896.

Specifications and Forms of Tender can be obtained by applying to Mr. John Marsland, Engineer and Manager, Gas-Works, Sowerby Bridge.

The Gas Committee do not bind themselves to accept the lowest or any tender.

Tenders must be sent in not later than Monday, May 25, 1896 endorsed "Tender for Coal" or "Cannel" respectively, and addressed to

GODFREY RHODES AND EVANS,
Clerks to the Council.

Commercial Bank Chambers, Halifax,
May 14, 1896.

BELPER GAS AND COKE COMPANY.

TENDERS FOR COAL AND COKE.

THE Directors are prepared to receive TENDERS for the supply at their Works, situate near the Railway Station, Belper, of 2000 Tons, more or less, of GAS COAL (part in the Gas Company's own Waggons); also about 200 Tons, more or less, of CANNEL COAL, to be delivered at such times, and in such quantities, as the Directors or their authorized Servants shall from time to time order.

Sealed tenders, stating price per ton of 21 cwt., and information as to the quality and quantity of Gas the Coal is estimated to produce, also as to where the same is now in use, to be sent to the undersigned, on or before Friday, June 5.

The Directors do not bind themselves to accept the lowest or any tender, or to take the whole of the above quantities of Coal or Cannel.

By order,
JOSEPH PYM,
Managing Director.

Belper, May 13, 1896.

FARNHAM GAS COMPANY, LIMITED.

TENDERS FOR COAL.

THE Directors of the Farnham Gas Company, Limited, are prepared to receive TENDERS from Persons willing to supply and deliver, free of all Dues and Charges, at the Farnham Station, London and South-Western Railway, 1900 Tons of the following descriptions of GAS COAL—viz., New Pelton, Pelaw Main, Aldwarke Main, or Stafford Silkstone, to be delivered in quantities of 50 Tons (at intervals) before the 31st of March, 1897. The Coal to be consigned to the order of the Farnham Gas Company, Limited, at the Farnham Railway Station.

In the case of Seaborne Coal the Meter's Certificate of each quantity to be duly sent with Invoice of same.

Payment monthly.

Sealed tenders, marked "Tender for Coal," to be delivered to the Secretary, Mr. W. Wells, 112, West Street, Farnham, Surrey, not later than Eleven o'clock a.m., on Saturday, the 30th of May, of whom Forms of Tender may be obtained.

The Directors reserve the right to reject the lowest or any tender.

Dated May 21, 1896.

BOLLINGTON URBAN DISTRICT COUNCIL
GAS-WORKS.

THE Gas Committee are prepared to receive TENDERS for the following:—

CONTRACT No. 1.—FIRE-CLAY MATERIALS.
CONTRACT No. 2.—RETORT-BENCH MOUNTINGS and sundry VALVES and CONNECTIONS.
CONTRACT No. 3.—GAS EXHAUSTER and STEAM-ENGINE.
CONTRACT No. 4.—WASHER-SCRUBBER.

The Drawings and Specifications may be seen at my Office, and at the Office of Messrs. Thomas Newbigging and Sons, Engineers, 5, Norfolk Street, Manchester.

Copies of the Bill of Quantities and Forms of Tender may be obtained from the latter on deposit of Two Guineas, which will be returned on a *bonâ-fide* tender being sent in.

Sealed tenders, endorsed as above, to be delivered to me not later than Twelve o'clock noon, on Saturday, the 30th day of May, 1896.

The Council do not bind themselves to accept the lowest or any tender.

WILLIAM KNIGHT,
Clerk.

Urban District Council Offices, Bollington,
May 14, 1896.

THE East Dereham Urban District Council are prepared to receive TENDERS for the supply of about 1200 Tons of screened GAS COAL for the ensuing Year.

Conditions and Forms of Tender to be had of the undersigned.

Tenders to be sent in by the 2nd of June, 1896, to

B. H. VORES,
Clerk to Urban District Council.

East Dereham, May 16, 1896.

SKIPTON GAS COMPANY.

THE Directors of this Company are prepared to receive TENDERS for the purchase and removal of the surplus TAR and AMMONIACAL LIQUOR produced at their Works during Twelve Months ending June 30, 1897.

Particulars may be obtained from the undersigned, to whom sealed and endorsed Tenders may be sent not later than June 8 next.

The Directors do not bind themselves to accept the highest or any tender.

J. HAIGH,
Secretary.

Skipton, May 15, 1896.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Leek Urban District Council invite TENDERS for the supply of best screened GAS COAL and NUTS, for One Year from the 1st of July, 1896, to be delivered at the Leek Station, on the North Staffordshire Railway, at such times and in such quantities as may be required.

Further Particulars and Forms of Tender to be obtained from the undersigned.

Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, not later than Four o'clock in the Afternoon of Monday, the 1st of June.

The lowest or any tender will not necessarily be accepted.

By order,
C. HENSHAW,
Clerk to the Council.

Town Hall, Leek,
May 13, 1896.

EDINBURGH AND LEITH CORPORATIONS GAS.

RESIDUAL PRODUCTS FOR SALE.

THE Edinburgh and Leith Corporations Gas Commissioners are prepared to receive separate TENDERS for the PURCHASE of the TAR and AMMONIACAL LIQUOR to be produced at their Works in Edinburgh and Leith respectively during the Three Years from the 1st of July next.

Forms of Tender, on which the offers must be made, and Copies of the Terms and Conditions upon which the Products are to be Sold, may be had on application to the Engineers at these Works.

Offers, endorsed "Tender for Edinburgh Works Residual Products," or "Tender for Leith Works Residual Products," will be received by the Subscriber on or before Saturday, the 6th prox.

The Commissioners do not bind themselves to accept the highest or any tender.

JAMES M'G. JACK,
Clerk.

25, Waterloo Place, Edinburgh,
May 13, 1896.

HEBDEN BRIDGE AND MYTHOLMROYD GAS BOARD.

TENDERS FOR COAL AND CANNEL.

THE Gas Board invite Tenders for the supply of 5000 Tons of GAS COAL and 700 Tons of CANNEL COAL, to be supplied in such quantities as may be determined by the Board during the Year ending the 30th of June, 1897.

Forms of Tender and further Information may be had on application to Mr. R. West, Manager, Gas-Works, Hebden Bridge.

Tenders, endorsed "Tender for Coal," must be addressed to E. J. Crossley, Esq., Chairman of the Gas Board, Crow Nest, Hebden Bridge, and sent in not later than the 25th of May, 1896.

The Board do not bind themselves to accept the lowest or any tender.

RICHARD CRABTREE,
Clerk to the Gas Board.

Crow Nest, Hebden Bridge,
April 30, 1896.

TO COAL CONTRACTORS AND OTHERS.

THE Sedgley Urban District Council invite TENDERS for supplying 750 to 1000 Tons of GAS COAL; the deliveries to be made at the Shut End Siding at such times and in such quantities as may be directed.

Sealed tenders, marked "Coal," must reach me on or before the 11th of June next.

The Council do not bind themselves to accept the lowest or any tender.

By order,
JOSEPH SMITH,
Clerk to the Council.

Offices: High Holborn, Sedgley,
May 13, 1896.

URBAN DISTRICT COUNCIL OF HAVERHILL.

TENDERS FOR COAL.

THE Council invite Tenders for the supply of 1200 Tons of the best screened SILKSTONE GAS COAL, to be delivered free at Haverhill Station during the period of One Year, from the 15th day of June next.

Delivery will be taken from time to time as the Manager shall require the same.

The Council reserve the right to divide the Contract in two of 600 Tons each.

The person whose tender is accepted will be required to enter into the usual Contract, and to give Security for due performance thereof.

Tenders, in sealed envelopes, endorsed "Tender for Coal," should be addressed and sent to me the undersigned not later than the 1st day of June next.

By order,
SIDNEY H. GRAHAM,
Clerk to the Council.

Haverhill, May 15, 1896.

ACCRINGTON DISTRICT GAS AND WATER BOARD.

TAR AND AMMONIACAL LIQUOR.

THIS Board are prepared to receive TENDERS for the purchase and removal of the TAR and AMMONIACAL LIQUOR, which may be produced at the Accrington and Great Harwood Works of the Board, during One Year, commencing on the 1st of July next, and terminating on the 30th of June, 1897.

The highest or any tender will not necessarily be accepted.

Sealed tenders, addressed to the Chairman of the Board, and endorsed "Tender for Tar and Ammoniacal Liquor," must be delivered at the Offices of the Board on or before Wednesday, the 10th of June.

Further Particulars may be obtained on application to Mr. C. Harrison, the General Manager.

By order of the Board,
A. H. AITKEN,
Clerk to the Board.

Offices of the Board, Accrington,
May 8, 1896.

UXBRIDGE AND HILLINGDON GAS CONSUMERS' COMPANY.

GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of 3500 Tons of GAS COAL, deliveries of which are to commence the first week of July, 1896, and finish the last week in May, 1897.

Tenders to be made out for 1000 Tons of best South Yorkshire unscreened Silkstone Gas Coal delivered in Trucks (free) at Uxbridge Railway Station, G.W.R. (each ton to contain 20 cwt.), and 2500 Tons of the best description of unscreened Gas Coal from the Durham Coal-Fields, delivered by Barge (free) alongside the Company's Works, Grand Junction Canal.

Tenders are to state the Names of the Pits from which the above description of Coal will be supplied; the same to be fresh wrought, and free from Slate and other Impurities, and to the entire satisfaction of the Company's Engineer.

Deliveries to be according to the requirements of the Company.

Tenders to be received on or before the 4th day of June next, addressed to the Chairman, Gas Company's Offices, Uxbridge, Middlesex, and endorsed "Tender for Coal."

A Form of Tender will be sent on application.

W. & W. M. GARDINER,
Secretaries.

Uxbridge, Middlesex,
May, 1896.

HAWORTH URBAN DISTRICT COUNCIL.

TENDERS are invited by the above Council for the supply of 2000 Tons of unscreened GAS COAL, to be delivered (in such quantities as the Council may determine) on Rails at Haworth Railway Station, within the ensuing Twelve Months.

Tenders to be forwarded to me the undersigned, marked "Coal Tender," on or before the 28th inst.

WM. ROBERTSHAW,
Clerk.

Burlington Chambers, North Street, Keighley,
May 15, 1896.

LURGAN GASLIGHT AND CHEMICAL COMPANY LIMITED.

COAL WANTED.

THE Directors invite Tenders for the supply of 2750 Tons of best (screened) GAS COAL, delivered into Lighters, *ex*-ship at Belfast, free of all Charges.

Delivery of 2500 Tons will be taken before the 1st of November next; the remainder to be delivered at such times before the 1st of April, 1897, as may be required. Vessels carrying from 200 to 300 Tons can at once deliver into Lighters, and these Lighters be back for a further Cargo within a period to be arranged and agreed upon by the Gas Company.

Tenders (in sealed envelope), accompanied by reference to Gas-Works using the Coal offered, should reach me not later than Eleven o'clock in the forenoon of Friday, the 29th of May, 1896.

The Directors do not bind themselves to accept the lowest or any tender.

FRED W. MAGAHAN,
Secretary.

Gas-Works, Lurgan,
May 4, 1896.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 23,000 Tons of GAS COAL for One Year from the 1st day of July next, in such monthly quantities as may be required by the Company.

Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or if sent (as preferred) by Water, the price f.o.b., and also the price delivered at the Gas Company's Wharf on the Gloucester and Berkeley Canal.

Further Particulars and Forms of Tender may be obtained of the Company's Engineer, Mr. R. Morland.

Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than the 6th day of June next.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
May 14, 1896.

STAINES AND EGHAM DISTRICT GAS AND COKE COMPANY, LIMITED.

TENDERS FOR COAL.

THE Directors of this Company invite TENDERS, for the supply and delivery of 800 Tons of EAST PONTOP, SOUTH PELAW MAIN, PELAW MAIN, RAVENSWORTH PELAW, LONDONDERRY, HOLMSIDE, or BOLDEN GAS COALS. The deliveries to commence after the 1st of November next, and to continue during the period ending on the 31st of October, 1897.

The Company's Works are on the Banks of the Thames; and the Coals must be delivered by Barge. They will be unloaded by the Company's Steam-Crane.

Forms of Tender, containing further Particulars, may be obtained upon application to the Secretary; and all further Information can be obtained from the Manager, Mr. Thomas Webb, at the Works, Egham.

The Directors do not bind themselves to accept the lowest or any tender.

Sealed tenders to be sent to the undersigned on or before the 3rd day of June, 1896.

JOHN ANTHONY ENGALL,
Solicitor and Secretary.

Staines, May 16, 1896.

Now Ready, Handsome Cloth, 9s. Post free,

GAS MANUFACTURE

(THE CHEMISTRY OF);

A HANDBOOK ON THE PRODUCTION, PURIFICATION, AND TESTING OF ILLUMINATING GAS, AND THE ASSAY OF THE BYE-PRODUCTS OF GAS MANUFACTURE.

For the Use of Students.

By W. J. ATKINSON BUTTERFIELD, M.A., F.C.S.,

Head Chemist, Gas-Works, Beckton, London, E.

WITH NUMEROUS ILLUSTRATIONS.

*** This work deals with the MOST MODERN DEVELOPMENTS of the subject; and the chapter treating of the BYE-PRODUCTS will be found of special interest.

London: CHARLES GRIFFIN & Co., Ltd., Exeter Street, Strand.

PETTIGREW'S PATENT

Sulphate of Ammonia Plant

ON THE CONTINUOUS SYSTEM

Is the newest in the Market, and is the outcome of practical experience in Sulphate Making.

Old Systems easily and cheaply converted.

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Write for Particulars, Testimonials, and References to

GEO. PETTIGREW & Co.,

GAS AND CHEMICAL ENGINEERS,

MIDDLESBROUGH-ON-TEES.

The Lists will close on or before Wednesday, the 20th day of May, 1896, for London, and the following day for the Country and Abroad.

THE EUROPEAN PETROLEUM COMPANY, LIMITED,

Incorporated under the Companies Acts, 1862 to 1890.

SHARE CAPITAL - - - - - - - £1,000,000.

In 500,000 6 per cent. Cumulative Preference Shares of £1, and 500,000 Ordinary Shares of £1.

Of the Share Capital, the Vendors have agreed to take 166,660 Preference Shares and 166,660 Ordinary Shares on account of their Purchase Money.

333,340 Preference Shares, and 333,340 Ordinary Shares are now offered for subscription. Payable—2s. per Share on Application, 3s. on Allotment, 5s. on June 24, 5s. on Aug. 24, and the balance on Oct. 24, 1896.

Applications will also be received for £400,000 4½ per cent. First Mortgage Debentures of £100 each, repayable on the 1st of May, 1911, at 5 per cent. premium. The Debentures will be secured by a Trust Deed, charging the Steamers hereinafter mentioned under registered statutory mortgages, and also the undertaking and the whole of the assets of the Company. Payable—£10 on Application, £10 on Allotment, £15 in two months, and the balance in four months.

Prepayments on Shares or Debentures may be made at any time, and Interest at the rate of Three per cent. per annum will be allowed on any such payments.

TRUSTEES FOR DEBENTURE HOLDERS.

Sir W. LAWRENCE YOUNG, Bart.
Sir H. SEYMOUR KING, K.C.I.E., M.P.

SOLICITORS TO THE TRUSTEES.

Messrs. WALTONS, BUBB, JOHNSON, & WHATTON, Leadenhall House, E.C.

DIRECTORS.

The MARQUIS OF GRANBY (Director Sun Insurance Office, and Sun Life Assurance Society), *Chairman.*
The EARL OF WINCHILSEA and NOTTINGHAM, *Vice-Chairman.*
LORD CLANMORRIS, Bangor Castle, Belfast.
JOHN STOREY BARWICK, Esq., Sunderland (Director North-Eastern Banking Company, Limited).
ROLAND Y. BEVAN, Esq. (Director Railway Passengers' Assurance Company).
WILLIAM FOWLER, Esq., 43, Grosvenor Square, London, W. (Chairman Messrs. John Fowler & Co., Limited, Leeds).
EDWARD GIBSON, Esq., London and St. Petersburg.
ARTHUR LAING, Esq. (Messrs. James Laing), Deptford Yard, Sunderland.
Lieu.-Col. ENGLISH, R.E., retd., } 21, St. Mary Axe, London, *Joint Managing-*
*ALFRED SUART, Esq., } *Directors.*
*Will join the Board after Allotment.

LOCAL MANAGERS.

PERIKLES TZIKOS, Esq., Palais Gresham, Budapest (*General Manager for Galicia and Roumania*).
A. ZATOUROFF, Esq. (*for Baku*).
F. A. WOMBWELL, Esq. (*for Grosney*).

BANKERS.

LLOYDS BANK, LIMITED, 72, Lombard Street, London, E.C., and their Branches.
BROWN, JANSON, & CO., 32, Abchurch Lane, E.C.

SOLICITORS.

Messrs. ASHURST, MORRIS, CRISP, & CO., 17, Throgmorton Avenue, London, E.C.

BROKERS.

Messrs. BRUNTON, BOURKE, & CO., 18, Finch Lane, London, E.C.

AUDITORS.

Messrs. COOPER BROTHERS & CO., 14, George Street, Mansion House, London, E.C.

SECRETARY (*pro tem.*) AND OFFICES.

Mr. G. F. LIND, 21, St. Mary Axe, London, E.C.

PROSPECTUS.

This Company has been formed to develop the trade in the subsidiary products of Crude Petroleum, to the supply of which, as well as of Kerosene, the Company proposes to direct its operations. With this view the Company will take advantage of an exceptional opportunity for establishing under one management a complete organization of existing businesses in the three branches of the Petroleum Industry, viz.:—

1. The production of Crude Oil.
2. Transport.
3. The refining, storage, and distribution of the various products.

Under such a combination, each branch can be worked for mutual advantage, and for the profitable results of such a system of co-operation in the Petroleum Industry it is only necessary to look to the brilliant history of the Standard Oil Company of America. This will effect a material reduction in the working expenses of each branch, and at the same time secure the regularity in supply direct from producer to consumer, which is alone required to ensure the rapid development of the trade in European Oil and its subsidiary products.

The nature of the Company's proposed operations has been laid before Mr. Boverton Redwood, the chief authority in this country; and he has consented to give the Directors the benefit of his advice on all technical questions.

In the year 1883, the importation of refined Petroleum into the United Kingdom was only 1,329,506 barrels; whereas in the year 1895, it was 3,332,909 barrels. The subsidiary products above referred to are—

(1) SOLAR OIL.—There is a large and increasing demand for this product for gas enrichment. Until recently gas was enriched mainly by Cannel Coal. But the supply of this material has greatly diminished in recent years; and the companies are manufacturing increasing quantities of gas from Solar Oil, the use of which renders any other enriching material unnecessary.

One firm alone, Messrs. Humphreys & Glasgow, have erected or have under contract 24 installations for various Companies, of an aggregate capacity of 25,000,000 feet per day, which in full work would require a supply of 100,000 tons of oil per annum. The Gaslight and Coke Company have installations of a capacity of 10,000,000 feet per day.

(2) LUBRICATING OIL.—Formerly animal and vegetable oils were almost exclusively used in machinery of the better class, at a cost of 3s. 6d. to 5s. per gallon. Now it has been found that mineral oil, in some cases mixed with others, gives the same result at a cost of from 9d. to 1s. 9d. per gallon.

(3) GASOLINE AND BENZINE.—Largely used in various trades; and a considerable demand may be expected for Gasoline and Light Oils as fuel for the motor cars now rapidly coming into use.

(4) RESIDUUM OR ASTATKI is largely used as fuel for locomotives and marine engines in Russia. The Great Eastern Railway have already 25 locomotives burning oil fuel, and are converting six engines to burn that fuel alone.

Until the recent establishment in England by the Vendors of a refinery for Crude Petroleum, each product has necessarily been imported and stored separately at a large cost. The Company will bring Crude Oil to this country in its own Tank-Steamers, refining it here so as to obtain the various products and supply them direct from the Refinery to the Consumer.

Further interesting particulars with regard to the nature and uses of Crude Petroleum and its products will be found in the accompanying extracts.

THE SOURCES OF SUPPLY.

One of the chief obstacles in the way of the development of the trade in the products from Crude Petroleum has hitherto been the uncertainty of supply. This Company will acquire possession of the Oil properties below referred to, which will, as the Directors are advised, provide an annual supply of between 250,000 and 300,000 tons of Crude Oil.

1. BAKU.—93 acres of freehold, and 19 of leasehold, capable of producing over 120,000 tons per annum.—*Reported on by* Dr. Dvorkovitz.

2. GROSNEY.—68 acres, held under lease for 29 years, yielding an aggregate of 2000 tons per day.—*Reported on by* Mr. J. S. Chambers.

3. ROUMANIA.—Properties about 3000 acres in extent on the Roumanian Oil belt.—*Reported on by* M. Emil Baum, Engineer to the Ministry of Agriculture, Commerce, Industry, and Domains, Bucarest.

4. GALICIA.—857 acres of freehold, and 1372 of leasehold land.—*Reported on by* Dr. Julius Noth, Member of the Imperial Geological Institute of Vienna, and the Royal Geological Institute of Budapest, except as to Tyrawa, which is reported on by Ritter von Wiecjkowski.

(The Reports on, and Valuations of, the above Properties can be seen at the Offices of the Company.)

5. The Company secures the benefit of a contract for the supply of 80,000 tons of Oil per annum, at about 6s. 8d. per ton.

TRANSPORT.

The Company acquires a Fleet of 14 Tank-Steamers valued by Mr. J. Fortescue Flannery, M.P., the principal authority on Tank-Steamers, at the sum of £443,000.

REFINING, STORAGE, AND DISTRIBUTION.

The Company proposes to arrange for refining at Baku, Grosney, Novorossisk, Kustendje, Hamburg; and in this country will acquire from the Vendors—

(1) The exclusive use for seven years of a recently erected refinery at Carlton, near Middlesbro', which is now refining at the rate of 500 tons per week, and of a new refinery at Ulverston, near Barrow, now turning out over 100 tons per week, and with a capacity of 200 tons per week.

(2) A freehold refinery, capable of refining 1000 tons per week with all accessory storage accommodation.

(3) Fifty tank-waggons.

The Company will also acquire from the Vendors—

(4) A complete storage installation at Bremen, of a total capacity of 9000 tons.

(5) A freehold storage installation at Harburg for 7500 tons, together with the plant, to be completed within four months.

PROFITS.

The statements certified by Messrs. P. Dvorkovitz, J. S. Chambers, E. R. Blundstone, A. W. Eastlake, and Sadler & Co., Limited, can be inspected at the Offices of the Company, and give in detail the results which may be expected from the operations of the Company, based on existing rates and prices, and an anticipated annual output of 250,000 tons of Crude Oil.

These certificates have been examined by Messrs. J. H. Duncan & Co., Chartered Accountants, who have compiled therefrom the following estimates of profit:—

Profit on Crude Oil—

	Tons.		
1. Baku	120,000	£41,000 0 0	
2. Grosney	80,000	13,334 0 0	
3. Roumania	20,000	16,000 0 0	
4. Galicia	30,000	33,100 0 0	
	250,000		£103,434 0 0
Profit on Refining in England			45,541 0 0
			£148,975 0 0
Adding to this total the average earnings of the steamers per annum (1893-95), as per the Certificate of Messrs. Cooper Brothers & Co., Chartered Accountants, which can be inspected at the Offices of the Company			66,066 0 0
(The earnings of the steamers will in future be merged in the general profits of the Company)			£215,041 0 0
Deduct—			
Management expenses and depreciation of plant, &c.		£36,000 0 0	
Depreciation of steamers, 7 per cent.		31,000 0 0	
			67,000 0 0
			£148,041 0 0
Deduct—			
4½ per cent. interest on £400,000 Debentures		£18,000	
6 per cent. on £500,000 Preference Shares		30,000	
Dividend on £500,000 Ordinary Shares, say at 10 per cent.		50,000	
			98,000 0 0
Leaving for Sinking Fund, Development of Properties and Contingencies			£50,041 0 0

PURCHASE PRICE.

The Vendors, who are the Promoters, have fixed the purchase price at £1,120,000, payable at the option of the Directors as to £166,660 in Ordinary Shares, £166,660 in Preference Shares, £133,330 in Debentures (the maximum in each case allowed by the rules of the Stock Exchange), and the balance in cash. A sum of £80,000 in cash will be reserved as Working Capital, leaving 200,000 Shares available for further working capital as and when required.

Application will be made for a Stock Exchange quotation as soon as possible.

For Contracts see Prospectus.

Prospectuses and Application Forms may be obtained from the Bankers and Brokers, and at the Company's Offices, 21, St. Mary Axe, London, E.C.

May 15, 1896.

THE EUROPEAN PETROLEUM COMPANY, LIMITED.

Capital £1,000,000, divided into 500,000 Six per cent. Cumulative Preference Shares of £1 each, and 500,000 Ordinary Shares of £1 each.

No.....

Issue of 333,340 Six per cent. Cumulative Preference Shares of £1 each, and 333,340 Ordinary Shares of £1 each.

FORM OF APPLICATION FOR SHARES. (This Form may be used.)

To the Directors of THE EUROPEAN PETROLEUM COMPANY, LIMITED.

GENTLEMEN,—

Having paid to your Bankers the sum of £....., being a deposit of 2s. per Share on application for.....Shares of £1 each in THE EUROPEAN PETROLEUM COMPANY, LIMITED, I hereby request that you will allot me these Shares, and I hereby agree to accept the same, or any less number that you may allot to me, upon the terms of the Prospectus dated May 15, 1896, and subject to the Memorandum and Articles of Association of the Company, and to pay the subsequent instalments when due; and I authorize you to place my name on the Register of Members in respect of the Shares allotted to me.

Signature .....

Name (in full).....

Address .....

Profession or Description.....

Date.....1896.

CITY OF CARLISLE.

THE Carlisle Gas Committee are prepared to receive TENDERS for the COAL and CANNEL required at their Works during One Year from the 1st of July next.

Tenders to be delivered to the undersigned not later than June 1, 1896.

Forms of Tender and other Particulars on application.

C. B. NEWTON,
Engineer and General Manager.

Gas-Works, Carlisle,
May 14, 1896.

CITY OF CARLISLE.

THE Carlisle Gas Committee are prepared to receive TENDERS for the surplus TAR produced at their Works for a period of One Year from the 1st of July next.

Tenders to be delivered to the undersigned not later than June 1, 1896.

Further Particulars can be obtained on application.

C. B. NEWTON,
Engineer and General Manager.

Gas-Works, Carlisle,
May 14, 1896.

THE Widnes Corporation invite Tenders for the supply of about 18,000 Tons of GAS COAL (Slack, "Through and Through," or Screened Coal) for the period ending the 30th of June, 1897, to be delivered at the Gas-Works, Widnes.

Conditions and Forms of Tender may be obtained from Mr. I. Carr, Assoc.M.Inst.C.E., Gas Engineer, Widnes.

Tenders, endorsed "Gas Coal," to be delivered to the undersigned, on or before the 21st of May inst.

The lowest or any tender not necessarily accepted.

H. S. OPPENHEIM,
Town Clerk.

Town Hall, Widnes,
May 6, 1896.

WARE GASLIGHT AND COAL AND COKE COMPANY, LIMITED.

COAL SUPPLY.

THE Directors of the above Company invite TENDERS for the supply of from 900 to 1200 Tons of EAST PONTOP, NEW PELTON, or PELAW MAIN GAS COALS, to be considered at their meeting to be held on Tuesday, the 2nd day of June next.

Full Particulars may be obtained on application to me the undersigned at my Office.

By order,
GEO. H. GISBY,
Secretary to the Company.

Baldock Street, Ware, Herts,
May 14, 1896.

LONGWOOD GAS COMPANY.

TAR AND AMMONIACAL LIQUOR.

THE Directors of the above Company are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR made at their Works during the Year ending June 30, 1897.

Price per ton for Liquor per degree at 5° and 6° Twaddel.

The estimated quantity for disposal is about 1000 Tons.

Tenders, sealed and endorsed, to be sent in not later than Thursday morning, May 21, addressed to Edward Armitage, Esq., J.P., Chairman, Longwood Gas Company, Huddersfield.

By order,
JOHN L. MITTON,
Manager and Secretary.

LINCOLN CORPORATION.
(GAS DEPARTMENT.)

TENDERS FOR TAR.

THE Gas Committee of the Corporation of Lincoln are prepared to receive TENDERS for the purchase of the surplus TAR (about 800 Tons) produced at their Works during the period of One Year, commencing on the 1st of July, 1896.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Residuals," must be delivered at the Gas Offices, Lincoln, on or before the 25th inst.

The Committee do not bind themselves to accept the highest or any tender.

Other Particulars may be obtained of the undersigned.

JNO. CARTER,
Manager.

Gas-Works, Lincoln,
May 6, 1896.

SUTTON-IN-ASHFIELD URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

TENDERS FOR COAL, TAR, AND AMMONIACAL LIQUOR.

COAL—The Gas Committee of the above District Council are prepared to receive TENDERS for the supply of 3000 Tons of well-screened GAS COAL, to be free from Shale and Pyrites, and to be delivered at the Town Station, Sutton-in-Ashfield, in such quantities as the Manager shall from time to time direct, between July 1, 1896, and June 30, 1897.

TAR AND LIQUOR—TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at their Works from July 1, 1896, to June 30, 1897.

Tenders to state price per ton of 20 cwt. at the Works or at Sutton Town Station.

Tenders, endorsed, to be addressed as under, so as to arrive not later than the 2nd day of June, 1896.

By order,
JOHN D. FIDLER,
Clerk to the Committee.

District Council Offices,
Sutton-in-Ashfield, Notts.,
May 14, 1896.

TAUNTON GASLIGHT AND COKE COMPANY.

THE Directors are prepared to receive TENDERS for COAL for delivery over One Year, commencing the 1st of July next.

Particulars may be obtained on application to

A. EDWARDS,
Secretary and Manager.

May 11, 1896.

MARKET HARBOROUGH GAS COMPANY, LIMITED.

THE Directors of the above Company invite TENDERS for the supply of 3000 Tons of fresh wrought screened GAS COALS, to be supplied during the ensuing Twelve Months.

Also TENDERS for the supply of about 30 Tons of SULPHURIC ACID.

Sealed tenders to the Chairman, by the 28th inst.

Further Particulars from the Manager,

J. FRYER.

TENDERS FOR GAS COAL, ETC.

THE Directors of the Oakengates and St. George's Gas Company invite TENDERS for the supply of 1600 Tons of the best screened GAS COAL, delivered free at the Oakengates Station in such quantities as may be required from June 30, 1896, to June 30, 1897.

Tenders, endorsed and accompanied by an Analysis of the Coal offered, to be sent to the Manager on or before June 19, 1896.

Tenders also invited for the supply of Lime and the purchase of Tar and Ammoniacal Liquor for One Year.

The Directors do not bind themselves to accept any tender.

EDWARD PARKER,
Manager.

May 15, 1896.

TO CONTRACTORS.

THE Directors of the Holyhead and North Wales Gas and Water Corporation, Limited, are prepared to receive TENDERS for the erection of a THREE-LIFT TELESCOPIC GAS-HOLDER at their Holyhead Gas-Works; also for the REMOVAL and RE-ERECTION of the existing GAS-HOLDER.

Full Particulars may be had on application to the Company's Engineer, Mr. G. E. Saville, Farrar Road, Bangor, North Wales.

Sealed tenders to be sent in to the Chairman of the Company at this Office not later than Tuesday, the 26th inst.

By order,
W. H. SINCLAIR,
Secretary.

9, 10, 11, "Examiner" Buildings,
Manchester.

CORPORATION OF LEICESTER.

COAL TENDERS.

THE Gas and Electric Lighting Committee of the above Corporation are prepared to receive TENDERS for the supply of COAL, COBBLES, or NUTS for One or Two Years ending May 31.

Particulars and Form of Tender can be obtained on application to the Engineer.

Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Gas Coal," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, the 6th of June next.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Offices: Millstone Lane, Leicester,
May 16, 1896.

BOROUGH OF DONCASTER.

TENDERS FOR COALS.

THE Gas Committee of the Borough of Doncaster are prepared to receive TENDERS for the supply of 14,000 Tons of best GAS COAL during a period commencing July, 1896, and terminating June 30, 1897.

Particulars and Tender Forms may be obtained on application to John Athron, Esq., Chairman, or to the undersigned.

Tenders should be sent, under seal, to the Chairman, endorsed "Tender for Coal," not later than Ten a.m. on Tuesday, the 2nd of June next.

By order of the Gas Committee, who do not bind themselves to accept the lowest or any tender.

RT. BRIDGE,
Engineer.

Gas-Works, Doncaster,
May 9, 1896.

MILLOM URBAN DISTRICT COUNCIL.

TENDERS are invited for the supply of from 1600 to 2000 Tons of GAS COAL at such times and in such quantities as the Council may require during Twelve Months from the 1st of June next.

The Coal must be of the best quality, and as free as possible from Bats, Pyrites, and Dross.

Full Particulars of the Coal and Colliery, and an epitome of the Working Analysis to be given.

The price per ton, delivered free at Millom Station, and (where applicable) at the nearest and most available Port to the Colliery or Depôt, to be stated.

Sealed tenders on forms (which can be had on application to the undersigned), endorsed "Tender for Coal," to be sent in to me not later than the 25th inst.

The Council will not be bound to accept the lowest or any tender.

W. T. LAWRENCE,
Clerk to the Council.

Council Offices, Millom,
May 15, 1896.

BOROUGH OF KENDAL.
(GAS AND WATER DEPARTMENTS.)

THE Gas and Water Committee of the Corporation of Kendal are prepared to receive TENDERS for the supply (for One, Two, or Three Years) of—

3000 to 4000 Tons of best screened GAS COAL per annum,
1000 Tons of CANNEL COAL per annum,
300 to 400 Tons of NUT COAL, BURGY, or SLACK per annum (for Steam Purposes),

To be delivered, carriage paid, to Kendal Station, or in Boats alongside the Corporation Wharf on the Lancaster and Kendal Canal, in such quantities as may be from time to time required.

Form of Tender and full Particulars may be obtained from the undersigned.

Sealed tenders, endorsed "Tender for Coal," to be sent addressed to the Chairman of the Gas and Water Committee, Gas-Works, Kendal, on or before Monday, May 25, 1896.

The Corporation do not bind themselves to accept the lowest or any tender.

T. N. RITSON, Assoc.M.Inst.C.E.,
Engineer and Manager.

Gas-Works, Kendal,
May 13, 1896.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.

Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

BY ORDER OF THE DIRECTORS OF THE ENFIELD GAS COMPANY.

ISSUE OF NEW SHARES.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, London, E.C., on MONDAY, June 8, at two o'clock precisely, in lots, 900 £10 SHARES (fully-paid) in the above Undertaking, ranking for a Maximum Dividend of 7 per cent. per annum; the last Dividend on this class of Shares having been at this rate.

Particulars of the SECRETARY, at the Offices, ENFIELD TOWN; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C., and TOTTENHAM.

Gas and Water Stocks and Shares of the Capital Value of upwards of £15,000 brought into the Market by order of the Executors, and

TO BE SOLD BY AUCTION BY

MR. ALFRED RICHARDS at the Mart, Tokenhouse Yard, E.C., on Monday, June 15, at Two o'clock precisely, in Lots.

The Stocks and Shares are in the following Undertakings:—

Crystal Palace District Gas Company, £2412 Stock.
Barnet District Gas and Water Company, £1305 Stock.
Hastings and St. Leonards Gas Company, 36 £20 Shares.
Bournemouth Gas and Water Company, 84 Shares.
Worthing Gaslight and Coke Company, 117 £10 Shares.
Chipping Norton Gas Company, 211 Shares.
Ascot District Gas Company, 83 £10 Shares.
Wandsworth and Putney Gas Company, £76 10s. Stock.
Enfield Gas Company, 11 £10 Shares.
Winchester Water and Gas Company, 12 £25 Shares.
West Kent Gas Company, 17 Shares.
Portsea Island Gas Company, 7 Shares.
Bognor Gas Company, 5 Shares.
Soham Gas Company, 30 £10 Shares.

All paying good Dividends and offering Investments of the very highest character.

Full Detailed Particulars, when ready, may be obtained of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

IMPORTANT SALE OF CHICHESTER GAS COMPANY'S SHARES.

TO BE SOLD, by Auction, by Messrs. WYATT AND SON, on Wednesday, the 20th of May, 1896, at the Dolphin Hotel, Chichester, at Three o'clock precisely, in 50 Lots, by order of the Directors of the City of Chichester Gas Company, FIVE HUNDRED £10 SHARES in the above Company, being the first portion of the Additional Capital authorized to be raised by the Cnichester Gas Order, 1881. The Maximum Dividend authorized is 7 per cent.

Printed Particulars, with Conditions of Sale and full Information, may be obtained of Messrs. RAPER, FREELAND, and TYACKE, Solicitors, West Street, CHICHESTER; of ALFRED LASS, Esq., 30, Gracechurch Street, LONDON, E.C.; R. S. CHURCH, Esq., Secretary at the Company's Offices, the Gas-Works, CHICHESTER; and of Messrs. WYATT AND SON, Auctioneers and Valuers, East Street, CHICHESTER, HAVANT, and ARUNDEL.

This Day is published Vol. III. (962 *pages, with* 248 *Illustrations*), *Price* £2 2s.

Completing the Second Edition, in Three Volumes (£6 6s.), of

THE MANUFACTURE OF

SULPHURIC ACID AND ALKALI,

WITH THE COLLATERAL BRANCHES,

By GEORGE LUNGE, Ph.D.,

Professor of Technical Chemistry at the Federal Polytechnic School, Zurich (formerly Manager of the Tyne Alkali Works, South Shields).

STOCKPORT DISTRICT WATER-WORKS COMPANY.

ISSUE OF £5000 NEW ORDINARY STOCK.

BY the Stockport District Water Order, 1890, confirmed by the Water Orders Confirmation (No. 1) Act, 1890, the Stockport District Water-Works Company are authorized to raise, by way of New Capital, any further Sums not exceeding in the whole £82,000, by the issue of New Ordinary Shares or Stock, or New Preference Shares, or Stock, as therein mentioned.

The Company have resolved to create and issue £5000 NEW ORDINARY STOCK.

The said Order provides that the Company shall not in any Year make out of their Profits any larger Dividend on such New Ordinary Stock than £7 in respect of every £100 actually paid up of such Stock.

The Directors of the Company are now prepared to receive TENDERS for the purchase of such £5000 of New Ordinary Stock in lots of £100 each nominal value.

No Tender will be accepted for any Lot at a price less than the reserve, which cannot be less than the nominal value of such lot.

Every tender shall be deemed to be made subject to the conditions herein mentioned, and to the conditions of the said Order.

Tenders must be made on or before Monday, the 25th day of May, 1896.

The Directors do not bind themselves to accept any tender.

Forms of Tender and full Particulars can be obtained at the Company's Office, or at the Offices of Messrs. Earle, Sons, and Co., Solicitors, 54, Brown Street, Manchester.

Tenders must be addressed to the Directors of the Stockport District Water-Works Company, St. Peter's Square, Stockport, and endorsed outside "Tender for Stock."

By order,
ALFRED M. PRICE,
Secretary.

St. Peter's Square, Stockport,
April 23, 1896.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

COKE-BREAKERS,
PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT)
New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
165, QUEEN VICTORIA STREET, E.C.
And at STROUD, GLOUCESTERSHIRE.

HOLMSIDE GAS COALS.
PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton. . 11,205 Cubic Feet.
Illuminating Power, $16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality) $13\frac{3}{4}$ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.
PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton. . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . $13\frac{1}{2}$ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor $94\frac{1}{2}$ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COAL-FIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.
— *v.* —
"DE MARE" COMPANY

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.
— *v.* —
"SUNLIGHT" COMPANY,

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, HEREBY GIVE NOTICE, as follows:—

VALIDITY. The Company's Patent has been declared Valid on all points after a Fifteen-Day Trial.

NATURE OF INVENTION. The Invention was described by Mr. Justice Wills as a "Pioneer Invention."

SCOPE OF PATENT. The Patent has been given a wide construction; and it was held that the protection given by it was not confined to Mantles manufactured according to the particular prescriptions set out in the Specification.

SHAPE OF MANTLE. The Judge held that a Mantle, even if made in a different form or shape (such as the "De Mare" Fringe or Plume), is still an Infringement of the "Welsbach" Patent.

"DE MARE" JUDGMENT. Judgment for an Injunction, with full Costs, has been given against the "De Mare" Incandescent Gas-Light System.

"SUNLIGHT" JUDGMENT. Judgment was given against the "Sunlight" Incandescent Gas-Lamp Company, Limited, on the question of the Validity of the Plaintiffs' Patent.

"SUNLIGHT" MANTLES. Last about 100 hours.

"WELSBACH" MANTLES. Last about 1000 hours.

"Sunlight" Mantles burn double the gas to produce the same candle power as the Incandescent Gas-Light Company's Mantles.

Users of "Sunlight" Mantles are applying to the Incandescent Gas-Light Company to replace them by their own Mantles.

WARNING. Users of the Incandescent Gas-Light Company's Mantles upon "Sunlight" Burners are Infringers of the Company's Patent, and will be at once proceeded against.

COSTS. Certificates of the Validity of the Company's Patent have been granted both by Mr. Justice Romer and Mr. Justice Wills entitling the Company to Solicitor and Client Costs, which will, in all cases, be rigorously enforced.

INFRINGERS. Actions have been commenced, and are pending against Makers and Sellers of all forms of Incandescent Mantles. The Incandescent Gas-Light Company will take Proceedings against all persons infringing their Patent, whether,
MAKERS,
WHOLESALE DEALERS,
RETAILERS,
or
USERS.

"LIMITED LICENSE." Users of the Company's Mantles upon Burners not sold by the Company are Infringers.

WARNING. Judgments have already been obtained against such users from Mr. Justice Chitty, Mr. Justice Stirling, and Mr. Justice Kekewich.

FAITHFULL & OWEN,
11, Victoria Street,
Westminster.

Solicitors to the Incandescent Gas-Light Company, Limited.

April, 1896.

NOTICE.

The attention of the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, having been again called to the Advertisements inserted in various papers by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the "Meteor" Incandescent Gas-Lights are an Infringement of their Patents, and that they will bring Actions for Infringement against all persons found dealing in any manner with such Lights, the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, HEREBY GIVE NOTICE that they are advised that the "Meteor" Incandescent Lights in no way infringe any of the Patents of the Incandescent Gas-Light Company, Limited, that an action has been commenced to restrain such threats, and that they are PREPARED TO FULLY INDEMNIFY ALL PURCHASERS, DEALERS, AGENTS, and USERS of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

WILSON, BRISTOWS, & CARPMAEL,
1, Copthall Buildings, London, E.C.,
Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.

Nov. 30, 1895.

THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

Shipments Promptly and Carefully Executed.

London Office: R. Cull, 31, Old Broad St., E.C.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH, N.B.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.

RAVENSTHORPE, near DEWSBURY.

HUNTER'S

OXIDE OF IRON.

James Hunter, Miner, and Shipper of

NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

5, PRINCES STREET, PORT GLASGOW.

Telegrams: "Hunter, Port Glasgow."

Established 1872.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

Analysis—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For Prices, &c., apply to the

HARTON COAL COMPANY,

LIMITED,

Newcastle-on-Tyne.

W. H. PARKINSON,

Fitter.

LITTLE & GRAHAM, Ld.

THE

INCLINED RETORT

SPECIALISTS

TRANSPORT APPLIANCE WORKS,

SMETHWICK,

BIRMINGHAM.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

For Prices and Particulars, apply to

S. J. DITCHFIELD,

SEAHAM HARBOUR, COUNTY OF DURHAM.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton	10,500	Cub. Ft.
Illuminating Power	16·9	Candles.
Coke (of good quality)	67·5	per Cent.
Sulphur	0·58	,,
Ash	2·73	,,

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·4 candles.
Coke	68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.

B Lombard Street, NEWCASTLE-ON-TYNE.

W. RICHARDSON, Fitter.

LOW MOOR BLACK BED GAS COAL.

YIELD OF GAS PER TON	10,375 CUBIC FEET.
ILLUMINATING POWER	17·50 SPERM CANDLES.
COKE	75 PER CENT.

Prices, f.o.r. or f.o.b., on application to

GEORGE & JOHN HAIGH,

RAVENS LODGE AND CONYERS' COLLIERIES,

DEWSBURY.

A TRIAL IS RESPECTFULLY SOLICITED.

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

Note.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,

Coal Owners, Newcastle-on-Tyne;

or

E. FOSTER & CO.,

12, John Street, Adelphi, London, W.C.

INCANDESCENT GAS-LIGHT COMPANY, LIMITED,

V.

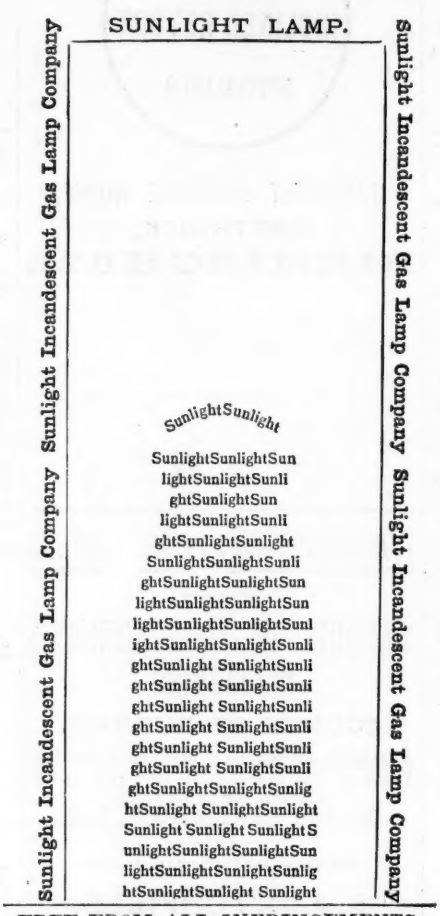
SUNLIGHT INCANDESCENT GAS-LAMP CO., LTD.

JUDGMENT FOR SUNLIGHT COMPANY.

EXTRACTS FROM JUDGMENT.

"No use is made by the Defendants of any of the 'rare earths;' and their choice of substances and their method of applying the illuminants appear to me to be as wide asunder as the poles from those contemplated by Welsbach."

Welsbach "could make no use of the great strength and tenacity of alumina." "The Sunlight process uses alumina very largely indeed."



EXTRACTS FROM JUDGMENT.

Welsbach Company's Counsel "both admit that they have no case unless the Welsbach skeleton, of whatever resistant earth oxides composed, is within the Welsbach Patent. Mr. Terrell says the consequences of an adverse decision on this point are very grave. I am very sorry if they are so; but I cannot help it. It seems to me that this is just what Welsbach did not claim."

FREE FROM ALL INFRINGEMENTS.

STRONG RESISTANT MANTLE.

PURE SOFT LIGHT.

CHEAP MAINTENANCE.

Applications for Agencies must be made to the New Company, viz.:—

NEW INCANDESCENT (SUNLIGHT PATENT) GAS LIGHTING COMPANY, LIMITED,

OFFICES:

40, COLEMAN STREET, LONDON, E.C.

SHOW-ROOMS:

79, QUEEN VICTORIA STREET, E.C.

STOURBRIDGE
RETORTS AND FIRE-BRICKS.
BEST QUALITY.
KING BROTHERS, STOURBRIDGE.
[See Illustrated Advertisement, May 5, p. 1006.]

OXIDE OF IRON.
NATURAL BOG ORE FROM OWN MINES.
Samples and Prices on application.
Wm. H. MÜLLER & CO.,
81, PALMERSTON BUILDINGS, LONDON, E.C.
TRADE MARK: "Compascum." Telegraphic Address: "FERRUM."

W. E. SANDER,
COMMISSION AGENT, BERLIN, 41, FRIEDRICH STR.
SPECIALITIES: Incandescent Lamp Burners and Mantles (with or without electric lighting from any distance, by button from the wall, etc.).
INCANDESCENT SPIRIT LAMPS.
Electro-technical Ware of all kinds.
IMPORT and EXPORT.

J. & W. HORTON
ETNA WORKS,
SMETHWICK,
NEAR BIRMINGHAM
(Established 50 Years),
PATENTEES
AND
MANUFACTURERS
OF
IMPROVED GASHOLDERS AND BOILERS
and Manufacturers of every description of
Gas Apparatus,
Cast and Wrought Iron Tanks, Purifiers, Condensers, Scrubbers, Retort-Lids, Cross-Bars and Screws, Wrought-Iron Boilers for Stationary, Portable, and Marine Engines, Sugar Pans, Coolers, Clarifiers, Punts, Boats, Bridges, Girders, Roofs, Cisterns, Oil-Tanks, Melting-Pots, Crucibles, Salt-Pans, Arch and Range Boilers, and every description of General Ironwork.
Drawings, Specifications, and Estimates supplied.

HEATHCOTE GAS COAL.
RICH IN ILLUMINATING POWER AND YIELD OF GAS.
ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.
MAINTAINS A HIGH STANDARD IN RESIDUALS.
THE GRASSMOOR Co., Ld., CHESTERFIELD.

GASEOUS FIRING A SPECIALTY.
Telegraphic Address: "DRAKESON, HALIFAX."
Telephone No. 43.
HALIFAX EXCHANGE.
GAS ENGINEERS. CONTRACTORS.
RETORT SETTERS. FURNACE BUILDERS.
IRONFOUNDERS. &c. &c.
SOLE MAKERS OF "MITTON'S" PATENT SELF-SEALING RETORT-LID.
SOLE MAKERS OF "SETTLE'S" PATENT COMBINED SEAL-REGULATING FLUSH-VALVE.
JONAS DRAKE & SON
SOLE AGENTS For "HISLOP'S" PATENT REGENERATIVE FURNACES. FOR ENGLAND, WALES & ABROAD.
OVENDEN, HALIFAX.
LONDON OFFICE: 60, QUEEN VICTORIA ST., E.C.

R. & A. MAIN,

GAS COOKING AND HEATING STOVES,

92, ALDERSGATE STREET, KINNING PARK,

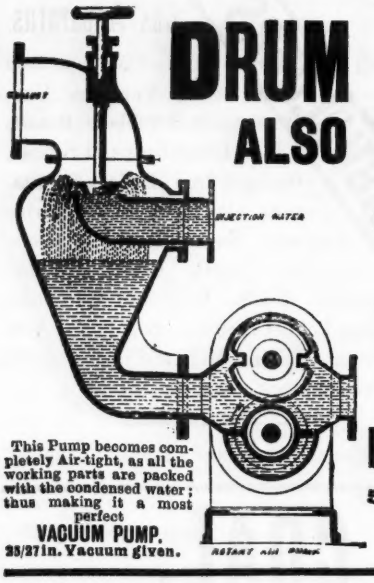
LONDON, E.C., & GLASGOW.

"The Force of the Piston Pump with the Capacity of the Centrifugal combined."

JOHNSON'S PATENT

DRUM PUMP AND EXHAUSTER

ALSO VACUUM PUMP AND CONDENSER.



This Pump becomes completely Air-tight, as all the working parts are packed with the condensed water; thus making it a most perfect

VACUUM PUMP.

25/27in. Vacuum given.

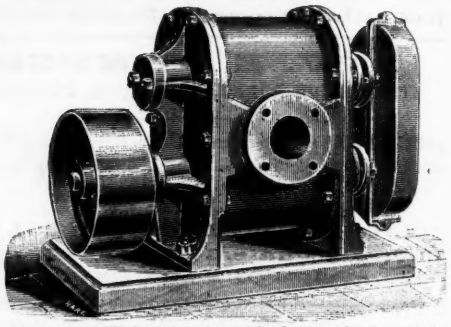
No Priming, Valves, or Frictional Working Parts.

The Pump of the future for quickly and economically moving large Bodies of Water, Semi-fluid, &c.

DRUM ENGINEERING Co.

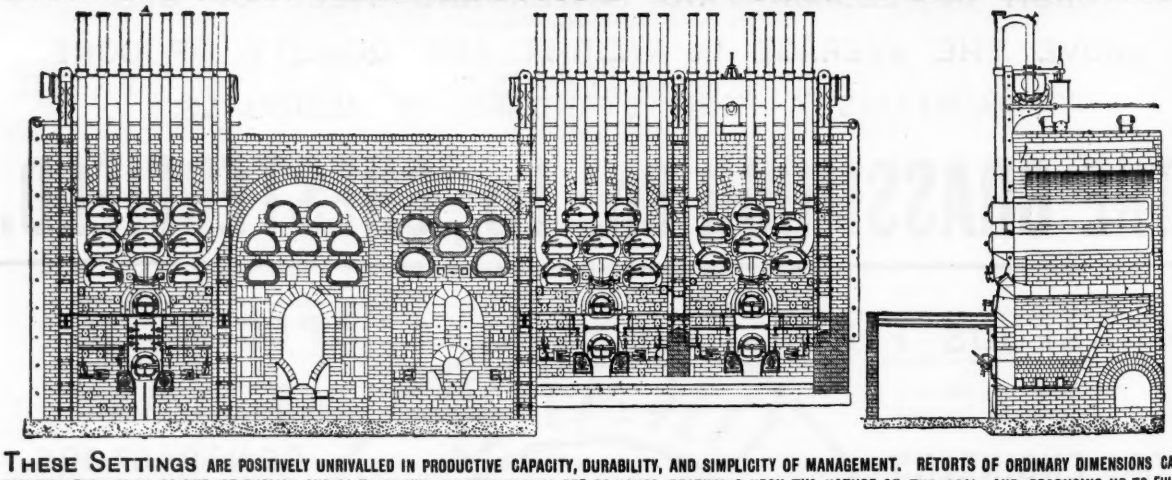
55, ATHOL ROAD,

BRADFORD.



Blowers and Exhausters guaranteed, even at a slow speed, to give a working pressure of 3 lbs. and upwards, and this without losing power by creating frictional Heat.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 28 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non.*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents, all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.

Further Information and Pamphlets from Principal Agent.

INCANDESCENT GAS-LIGHT

(Welsbach Patents).

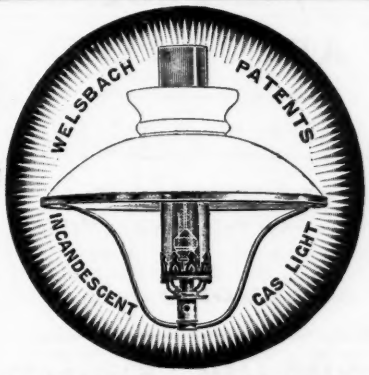
Further Great Reduction in Prices,

FROM MARCH 2, 1896,

Due to Colossal Sales,

Places this highly popular Light within the means of all classes.

The greatly Reduced Consumption of Gas COVERS THE INITIAL COST OF THE BURNERS IN FROM SIX TO EIGHT MONTHS.



The PRICES have been REDUCED as follows:—

The Ordinary "C" Burner to 6s. 6d.

The "C" Bye-Pass Burner to 7s. 6d.

Prices of other Patterns reduced proportionately.

SPECIAL ATTENTION IS CALLED TO THE

"S" BYE-PASS BURNER, PRICE 7s. 6d.

Which, with a Consumption of 2¼ Cubic Feet of Gas an hour, gives a light of 25 to 30 Candle Power.

This Pattern is particularly recommended where it is desired to effect a large saving in Gas rather than to effect a great increase in the Light.

The attention of Gas Managers and Gas Engineers is called to this System of Lighting as one which tends to Popularize the use of Gas as an Illuminant, owing to the following Advantages—

ECONOMY IN CONSUMPTION OF GAS, COMBINED WITH HIGH ILLUMINATING EFFICIENCY.

FREEDOM FROM SMOKE, DIRT, AND FLICKERING.

GREATLY REDUCED HEAT.

The *Lancet* Special Analytical and Sanitary Commission, in an exhaustive report, pronounces the Incandescent Gas-Light System to be the Healthiest, Best, and most Economical System of Gas Lighting.

SUITABLE FOR EVERY PURPOSE OF INSIDE OR OUTSIDE LIGHTING.

For further Particulars, apply to

The INCANDESCENT GAS-LIGHT CO., LIMITED,

Palmer Street, Westminster, London, S.W.

JAMES MILNE & SON, LTD.,

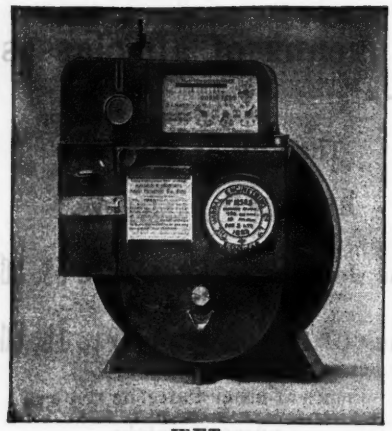
GAS ENGINEERS,

MILTON HOUSE WORKS, EDINBURGH.

LONDON. — GLASGOW. — LEEDS.

THE WIRRAL ENGINEERING COMPANY, LTD.

Patent New Prepayment Meters.

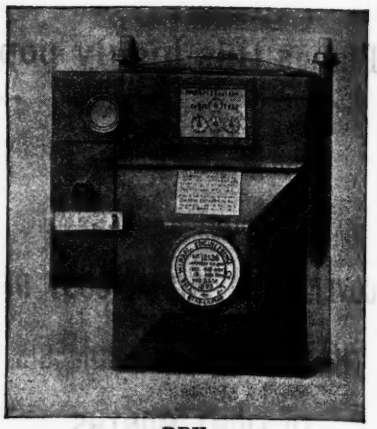


WET.

THE "PERFECT" AUTOMATIC.

Simple! Positive!! Accurate!!!

The only Prepayment Meter with no Springs, Counter-Balance Weights, or Frictional Gearing to get out of order.



DRY.

Particulars on Application to the COMPANY, 76, Hamilton Street, BIRKENHEAD.

Some of the Gas-Works and Local Authorities using Crosbie's Manufactures.

Aberdovey	Chesterton
Abergavenny	Clitheroe
Airedale	Cobham
Aldridge	Coleshill
Alfreton	Colombo
Antrim	Collingham
Armagh	Colney Hatch
Ascot	Coventry
Aylsham	Cranbrook
Ballymena	Cullen
Beaumaris	Deddington
Bentham	Dewsbury
Bewdley	Downpatrick
Bideford	Dursley
Birmingham	East Ardsley
Blackburn	Eastbourne
Bognor	Elland
Bollington	Ellesmere
Boreham	Elstree
Bramham	Eye
Brandon	Farnham
Bridgnorth	Felixstowe
Broadgreen	Garston
Broadstairs	Gillingham
Bromsgrove	Gorey
Broughty Ferry	Halesowen
Builth	Hanley
Burton	Hendon
Buxton	Hinckley
Cannock	Holywood
Carlow	Honiton
Castleford	Huelva
Chester le Street	Huntingdon

PAINTS FOR GAS-WORKS. PAINTS FOR GASHOLDERS.

Contractors to Her Majesty's Government, the Indian Government, the Natal Government, the Turkish Government, the Netherlands Railway, the London County Council, &c., &c.

CROSBIE'S PAINTS.

Guaranteed genuine and free from adulteration, and specially made to withstand Gaseous Fumes.

Catalogue and Testimonials on Application.

ADOLPHE CROSBIE, LTD.,

COLOUR WORKS, WOLVERHAMPTON.

Some of the Gas-Works and Local Authorities using Crosbie's Manufactures.

Hythe	Rochester
Ilkeston	Roscommon
Irthlingboro'	Rugeley
Johannesburg	Scarborough
Kegworth	Seaham Harbour
Kilrush	Seisdon
Kildwick	Shifnal
Kirkburton	Shipston-on-Stour
Knutsford	Sidmouth
Leamington	Skibbereen
Ledbury	Slough
Leek	Southam
Leven, N.B.	Southend
Limerick	Stafford
London	Stamford
Loughborough	Strood
Lymington	Stroud
Merthyr Tydfil	Swinton
Milborne Port	Sudbury
Napier (N.Z.)	Tetbury
North Middlesex	Tokio
Outlane	Uppingham
Pembroke	Uttoxeter
Penmaenmawr	Ventnor
Portadown	Warwick
Port Elizabeth	Wexford
Portrush	Wigston
Portsmouth	Willenhall
Pwllheli	Witney
Ramsey	Wollaston
Raunds	Wolverhampton
Richmond	Workington

ALEX. C. HUMPHREYS, M.Inst.C.E. A. G. GLASGOW, M.E.

MESSRS. HUMPHREYS & GLASGOW

Have constructed their EUROPEAN type of

CARBURETTED WATER-GAS PLANT

At the following Gas-Works:—

Copenhagen	700,000 Cub. Ft.	Liverpool	2,500,000 Cub. Ft.
Belfast	1,700,000 ,,	Brighton	1,250,000 ,,
Glasgow	300,000 ,,	Bath	1,000,000 ,,
Brussels	700,000 ,,	Preston	1,500,000 ,,
Santiago	400,000 ,,	Southport	750,000 ,,
Swansea	700,000 ,,	New York	1,000,000 ,,
Tottenham	600,000 ,,	Newburgh, N.Y.	350,000 ,,

And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Manchester	3,000,000 Cub. Ft.
Edinburgh	2,000,000 ,,	Brussels (Second Contract)	700,000 ,,
Tottenham (Second Contract)	750,000 ,,	St. Joseph, Mo.	750,000 ,,
Winchester	200,000 ,,	Holyoke, Mass.	500,000 ,,
Hoylake	125,000 ,,	Shanghai	225,000 ,,

In addition to which the previous Installations of The Gaslight and Coke Company under this System have a total capacity of 10,000,000 cubic feet per diem.

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Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

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TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE No. 200.
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Special Notice

TO GAS COMPANIES AND DISTRICT COUNCILS, ARCHITECTS, BUILDERS, AND CONTRACTORS.

The CHAMPION INCANDESCENT GAS-BURNER.

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We beg to advise our numerous friends and customers that the Champion Incandescent Gas-Burner still holds the field, and that our sales are increasing daily, notwithstanding the threats of our competitors.

Mantles are sold in any quantity without restriction for use of particular kinds, and are very durable.

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Established 1860.

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Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—
1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

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MACHINE-MADE GAS-RETORTS.

THE THAMES BANK IRON CO.
UPPER GROUND STREET, LONDON, S.E.,
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SOCKET-PIPES FOR GAS OR WATER PURPOSES.
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Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,
SIR WILLIAM ARROL & CO., Limited,
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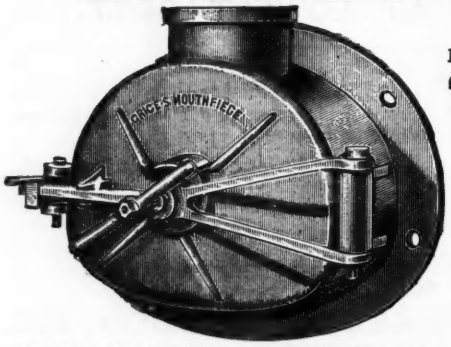

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A 280-CANDLE POWER
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less than half the price of any other Regenerative Lamp.
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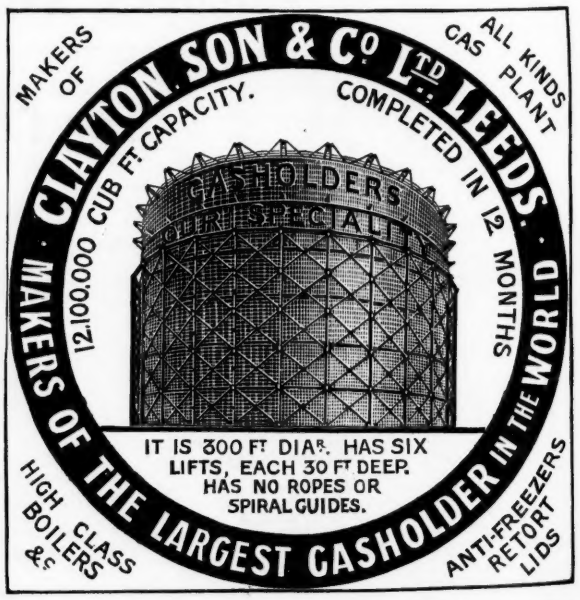
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ALL KINDS GAS PLANT
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Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

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Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

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Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

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The Apparatus has been supplied to the following Firms—

BURT BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
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PELOUZE & AUDOUIN'S

PATENT MECHANICAL CONDENSER.

Over 292,000,000 Cubic Feet of Gas per Day is passing through about 550 of these Machines.

Messrs. R. & J. DEMPSTER, Limited,

HAVE PLEASURE IN ANNOUNCING THAT THEY HAVE MADE ARRANGEMENTS WITH THE

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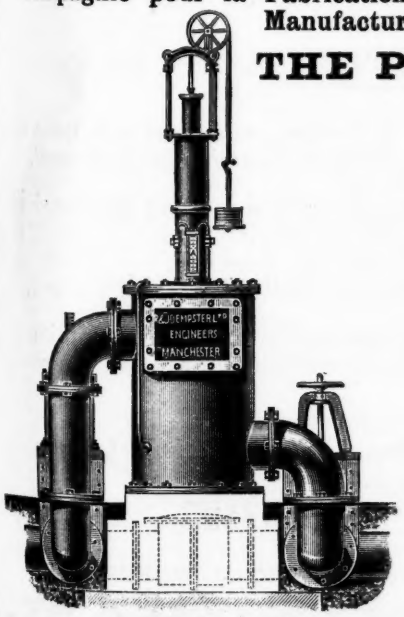

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This Apparatus is in very general use in most of the Gas-Works on the Continent and in America; over **550** being in use in different parts of the World for condensing and arresting all Tar Particles and Vapours from the Gases from Coal, Oil, and Wood.

The large number in use is sufficient proof of its utility. By the almost complete elimination of Tar, which is effected to the extent of 99·7 per cent., it facilitates Purification in the Purifiers, by preventing the clogging or obstruction of the Purifying Materials, which, in consequence, last much longer; thus effecting a Saving both in Materials and Labour.

So effective is this Apparatus that a piece of white paper placed over a Test-Tap on the Inlet of the Machine is immediately covered with Tar, whilst on the Outlet the white paper remains perfectly clean.

The Machines are made in the following sizes, for Works producing per 24 hours—

	Cubic Feet.		Cubic Feet.
0	35,000	5	500,000
1	70,000	6	700,000
2	140,000	7	1,240,000
3	210,000	8	1,750,000
4	350,000	For larger Makes, two Machines are recommended.	

For Prices and further Particulars, apply to the Sole Makers—

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GOLD MEDAL

GAS COOKER.

SPECIAL FEATURES.

May now be had with either Cast or Wrought Iron Enamelled Linings, very easily cleaned, and practically indestructible. The "Parkinson" Cooker is now fitted with the registered Cast-Iron Hinged Gate—an invaluable contrivance for ensuring a clean, well-ventilated Oven.

WHAT GAS ENGINEERS SAY:—

"I have no sort of hesitation in testifying to the excellence and effectiveness of the Gas Cookers. Give no trouble, bake admirably, and cook to perfection."

JOHN L. COCKER, *Merthyr Tydvil Gas Company.*

"They are giving our customers universal satisfaction."

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"The teachers express themselves as thoroughly pleased with them, and have put them to very considerable tests."

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"During last winter we used them at all the centres where we cooked by gas; and we shall continue to do so until we find they are superseded, which I consider unlikely."

MATILDA LEES DODS, Principal,
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"It is easy to manage, very good in its results, and most economical in the consumption of gas. Pastry, bread, cakes, and meat are all equally well cooked and beautifully browned in the oven. The grilling, boiling, and simmering arrangements are perfect."

I am, Gentlemen, yours faithfully,
(Signed) SOPHIE THWAITES, *International School of Cookery, Liverpool.*

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[See also Advt. p. 1080.

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